HEALTHY NEIGH BOUR HOODS

Evi Goedemans





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A research and design project
investigating the impact of
automated mobility on
urban health in residential
neighbourhoods in Almere

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A research and design project investigating the impact of automated mobility on urban health in residential neighbourhoods in Almere

28 June 2019

MSc graduation thesis in Urbanism
Technical University Delft
Faculty of Architecture, Urbanism and the Build Environment

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TU Delft Urbanism



Image 1: Neighbourhood childhood (own image)

Preface

This is the report of the graduation thesis Healthy Neighbourhood. The project investigates the **impact of automated mobility on urban health in residential neighbourhoods in the city of Almere.** The graduation project is part of the master Urbanism at the faculty of Architecture and the Built Environment at the TU Delft. The project will be executed within the studio of Urban Fabrics, and is guided by Marco Lub, from the chair of Urban Compositions, and Ulf Hackauf, from the chair of Environmental Technology and Design.

I would like to thank my mentors, friends and family for their guidance and support throughout this project. I hope you will enjoy reading this report: Healthy Neighbourhoods.

Evi Goedemans
June 2019, Delft

Abstract

Since the introduction of the car, our use of mobility is continuously growing (Kennisinstituut voor Mobiliteitsbeleid, 2018). Which leads to highly polluted areas, affecting urban health. Besides, the growing mobility results in a higher number of traffic accidents on the main road network (NU.nl, 2017).

And not only growing mobility, but also the urban development of our cities will have an influence on urban health. Suburban development causes a population level reliance on car use every day. This imposed reliance causes low physical activity levels in a lot of residential neighbourhoods among many industrialized countries (Badland & Schofield, 2005).

Physical inactivity, caused by dominance of the car in cities, the car dependency and infrastructural barriers in the city, can result in major health risks, especially in industrialized countries (Badland & Schofield, 2005). When engaging in physical activity, local streets and public spaces have been identified as the most suitable spaces (Badland & Schofield, 2005).

The introduction of automated mobility will provide car users with new possibilities to do while traveling. As a consequence, people are willing to travel longer, and the frequency of trips might increase (Stead et al., 2018). Automated forms of traveling will be chosen over active forms of travelling, because of the ease and comfort of automated vehicles. All of this results in more and more cars on the streets and an increased traffic complexity.

Summing up, the ever-growing mobility puts urban health at risk. On top of this, the introduction of automated mobility is posing a threat on various facets of urban health (personal lifestyles, accessibility, etc.), especially in residential neighbourhoods (because of the high car dependency).

The following question is leading in this project: **''How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?''**

Since this project is concerned with the topic automated mobility and the impact of it urban on health, the research type is a predictive one. Automated mobility is still in an early stage, it is uncertain what will happen in the future. Therefore, scenario planning will be at the heart of this project.

For the progressive scenario a design is made for two neighbourhoods in Almere. Urban regeneration strategies are developed with a set of design elements and recommendations. Creating and retrofitting urban environments which will improve urban health.

Promoting physical activity through urban design at the micro scale (neighbourhood scale) is one of the most effective measures to improve urban health. On top of this, strategies in reducing air pollution on the macro scale (city scale) will also be highly impactful in reducing diseases worsened by poor air quality. Besides, in the development of urban areas (on the district scale) a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018). Slow traffic should get the full priority, therefore fast automated vehicles are only allowed on a limited number of roads.

Image 2: Cover Healthy Neighbourhoods (own image)

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Image 3: Amsterdam Metropolitan Area (adjusted image: Google Earth, 2018)

Introduction project

In this report the graduation thesis Healthy Neighbourhood will be discussed.

Studio

This project will be executed within the studio Urban fabrics. The studio urban fabrics is concerned with the physical forms of urban areas. Also, it focuses on the relationships between urban forms and social processes. Within different contexts the relationships between the tangible and intangible structures will be elaborated.

This year the studio focuses on the topic Automated Mobility. Exploring the possible impact of technological and societal innovations on the built environment will be key. Scenario's will be used to inventory and analyse the different impacts. The focus area of this studio is the Amsterdam Metropolitan Area.

Due to the ease and comfort of automated mobility, and the obtained road capacity, it is to be expected that the amount of cars and the frequency of travels will increase. Exploring the possible impact on the built environment and the partly intangible subject urban health, this project aims to improve urban health in residential neighbourhoods, by using automated mobility as catalyst.

Project

Since the introduction of the car, our use of mobility is continuously growing (Kennisinstituut voor Mobiliteitsbeleid, 2018). Which leads to highly polluted areas, affecting urban health. Besides, the growing mobility results in a higher number of traffic accidents on the main road network (NU.nl, 2017).

And not only growing mobility, but also the urban development of our cities will have an influence on urban health. Suburban development causes a population level reliance on car use every day. This imposed reliance causes low physical activity levels in a lot of residential neighbourhoods among many industrialized countries (Badland & Schofield, 2005).

Physical inactivity, caused by dominance of the car in cities, the car dependency and infrastructural barriers in the city, can result in major health risks, especially in industrialized countries (Badland & Schofield, 2005). Active forms of traveling can contribute to a healthier lifestyle (Frank & Engelke, 2001). When engaging in physical activity, local streets and public space have been identified as the most suitable spaces (Badland & Schofield, 2005).

The introduction of automated mobility will provide car users with new possibilities to do while traveling. As a consequence, people are willing to travel longer, and the frequency of trips might increase (Stead et al., 2018). Automated forms of traveling will be chosen over active forms of travelling, because of the ease and comfort of automated vehicles. All of this results in more and more cars on the streets and an increased traffic complexity.

Summing up, the ever-growing mobility puts urban health at risk. On top of this, the introduction of automated mobility is posing a threat on various facets of urban health (personal lifestyles, accessibility, etc.), especially in residential neighbourhoods (because of the high car dependency).

Since the largest part of our society lives in residential neighbourhoods, and in these areas is a high car dependency, this project will focus on residential neighbourhoods. For the scope of this project Almere is chosen as location, because this city is the embodiment of residential areas.

The hypothesis of this project is: the implementation of automated mobility can contribute in improving urban health in residential neighbourhoods.

The following question is leading in this project:

''How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?''

Since this project is concerned with the topic automated mobility and the impact of it on urban health, the research type is a predictive one. Automated mobility is still in an early stage, it is uncertain what will happen in the future. Therefore, scenario planning will be at the heart of this project. Scenario planning takes into account a range of possible futures which includes its uncertainties as a whole (Peterson et al., 2003).

Outline project

The first chapter of this graduation thesis, Project, will emphasise on the content of the project. Here the motivation, problem field, context, problem statement, aim and research questions will be addressed.

The second chapter Methodology will elaborate more on the methods and research methodologies used in the project. It will describe which methods will be used to answer the research question and sub-research questions and which research methodologies are used within the project.

The research question and sub-research questions will be gradually answered throughout the rest of the report. The sub-research questions are divided into 6 themes. The themes are Situation, Methods, Urban Health, Healthy neighbourhoods, Automated mobility, and Design.

Before the chapters corresponding with the sub-research themes start, the chapter Suburbia Almere elaborates on the broader context of Almere. It describes the origin of the city, its motives and its goals.

Then , the fourth chapter elaborates on the situation of the chosen neighbourhoods, with their characteristics and mobility patterns.

The fifth chapter focusses on the main method used in this project, namely scenario construction. Three main scenarios will be developed as base of the project.

In the sixth chapter the topic of urban health will be further explored. This chapter is looking for principles and qualities which can be used to create healthy environments by urban planning.

The following chapter Healthy neighbourhoods provide the building blocks for a health neighbourhood and proposes a strategy in tackling the design of the two selected neighbourhoods.

The chapter Automated mobility chapter dives into the development of automated mobility And how the three main scenarios of automated mobility will have an impact on the neighbourhoods.

The Design chapter will bring all the gained information, strategies, principle and interventions together in a design on several scales. This will be done by developing urban regeneration strategies with a set of design elements and recommendations for two specific existing residential neighbourhoods. Creating and retrofitting urban environments which will improve urban health.

The report will be closed with the conclusions and a reflection.

Introduction AMA

The Amsterdam Metropolitan Area (AMA) consists of 33 municipalities located within 2 provinces, North Holland and Flevoland. The different municipalities bring their unique character and qualities, which contribute to a diverse and strong regional image. There is a large variety of ecological landscapes and a number of attractive historical cities. The AMA is the financial district of the Netherlands - it has numerous seaports, greenports, two airports (Schiphol & Lelystad), the Zuidas, the Media Valley, and a lot more (Metropool Regio Amsterdam, n.d.).

As one of Europe's most important economic areas (top 5), the number of residents and activities continuously grow. This growth places a high demand on the accessibility, liveability and sustainability of the metropolis. Smart mobility solutions help move people and goods faster, cleaner and easier through the increasingly busier AMA. This applies to the entire region, from bustling old city centres to rural areas. Important themes within Smart mobility are smart use of data, smart vehicle technology, mobility as a service, and smart design of the physical and digital infrastructure (see image 4) (Metropool Regio Amsterdam, 2017).

The cities and villages in the AMA are attractive for residents, visitors and businesses, due to the high-quality facilities, excellent liveability and good connections with the rest of the country and the world. Houses are being built, tourism has been increasing for years and companies continue to establish themselves in this area. The proximity of space and greenery outside the city are of great value. Moreover, the transition to a more sustainable metropolitan region with a cleaner economy is in full swing; this leads to opportunities for innovations, activity and improved quality of life. All these developments have an impact on mobility in the region (Metropool Regio Amsterdam, 2017).

Due to the growth of the Amsterdam Metropolitan Area, accessibility is increasingly coming under pressure. New mobility solutions must enhance the quality of life, economic and social development and sustainability of the region (Metropool Regio Amsterdam, 2017).

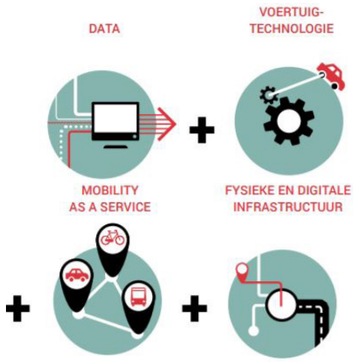


Image 4: Themes smart mobility (Metropoolregio Amsterdam, 2017)



Image 5: Ambitions smart mobility (Metropoolregio Amsterdam, 2017)



Image 6: Space for people? (City Metric, 2014)

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PROJECT



Image 7: Childhood neighbourhood (own image)

VS



Image 8: Schiedam – Car dominance (onw image)

Motivation + gap

Image 7 shows a picture of the street where I grew up. In this street there were no cars. There was a lot of space to walk, bike and play. However, image 8 shows that this is not always the case. A lot of Dutch residential neighbourhoods are dominated by cars, which leaves little or no space for the people. The availability of quality public open space has an effect on physical activity patterns in neighbourhoods. Accessibility and safety of public space influence the levels of physical activity in an area (Koohsari et al., 2015). High levels of inactivity can lead to a number of non-communicable diseases like obesity, diabetes, some cancers, heart diseases, and depression (Frank & Engelke, 2001; Hoehner, Brennan, Brownson, Handy, & Killingsworth, 2003).

When engaging in physical activity, local streets and public spaces have been identified as the most suitable spaces (Badland & Schofield, 2005). However, despite the combined efforts in preventing health outbreaks in the 19th century, the disciplines of public health and urban planning went their separate ways (Corburn, 2004; Hoehner et al., 2003). Leading to a number of uncoordinated attempts to address the health of urban populations (Corburn, 2004). Many planners still do not fully understand the health consequences of environmental factors (Srinivasan, O'Fallon, & Dearry, 2003). Now, for the last few decades the fields are attempting to reunite again, the question on how to stimulate people to walk and cycle more is in this leading. Urban health practitioners are concerned about the physical inactivity rates, while the urban planners are concerned about the environmental impact of the car (Hoehner et al., 2003). It is necessary to bring the both fields together again, because both approaches are essential for achieving significant changes in health behaviour (Hoehner et al., 2003). Still, it is not always clear what the exact impact of the physical environment on urban health is (Koohsari et al., 2015). That's why the project is focusing on this issue.

But the disconnect of the urban health and urban planning field is not the only pressing factor in this paradigm of urban health and urban planning. The developments in the automated mobility industry have a big influence on the way we travel and influence therefore as well our use of active travel modes (walking, cycling, etc.) (Stead et al., 2018). This has a big impact on the urban health. Without careful management of -automated- mobility, the car dominance might increase, and active transport will suffer (Stead, 2018).

To sum up, this project is focusing on the impact of -automated- mobility on urban health in residential neighbourhoods. It is looking for urban regeneration strategies creating healthy environments for residential neighbourhoods. The design will be used in an advisory manner. It is used as tool to test the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods, recommendations will set up to guide planners and designers in designing healthy neighbourhoods in a future with automated mobility.

Since this project will be carried out in one academic year, the project will focus on two types of residential post-war neighbourhoods. The two types of neighbourhoods differ in the proximity and accessibility to public services, and the dependency on the car. The neighbourhoods will be introduced later on in this chapter.

Problem field

Growing mobility
Since the introduction of the car, our use of mobility is continuously growing (Kennisinstituut voor Mobiliteitsbeleid, 2018). Which leads to highly polluted areas as the Randstad and the AMA region. Besides traffic contributes to air and noise pollution it also affects traffic accidents. The growing mobility results in a higher number of traffic accidents on the main road network (NU.nl, 2017), and is globally the eight leading cause of death, mainly of people between the 15 and 25 years old (Pineo & Rydin, 2018). Again, influencing the urban health.

Suburban development and car-use
Not only growing mobility, but also the urban development of our cities will have an influence on urban health. In many industrialized countries there is a reduced population density in cities and an increased urban sprawl. Suburban development causes a population level reliance on car use every day (which again will lead to a growing mobility) (Badland & Schofield, 2005).

Not only neighbourhoods are designed based on this car reliance, also facilities and services are no longer designed to be accessible by public transport or by active modes of transport. This can also cause changes in community perceptions and cohesion. This imposed reliance on cars causes low physical activity levels in a lot of sub-urban residential neighbourhoods among many industrialized countries (Badland & Schofield, 2005).

Physical (in)activity
Our sedentary lifestyles and the lack of physical activity is causing major health risks, especially in industrialized countries. Annually, approximately 1.9 million deaths are caused by physical inactivity (Badland & Schofield, 2005). Easy executable and moderate forms of physical activity, like bicycling and walking, can already contribute to a healthier lifestyle. It can reduce the risk of getting non-communicable diseases like obesity, heart diseases, diabetes (type 1), some cancers, anxiety, depression, and so on (Frank & Engelke, 2001). Altogether this means that environments can act as enablers (or disablers) of health behaviour. When engaging in physical activity, local streets and public space have been identified as the most suitable spaces to intervene (Badland & Schofield, 2005), they can act as health promotive environments. These environments promote the well-being of the people living in an area, by stimulating human interactions with an environment over time (Frank & Engelke, 2001).

There are, however, some barriers which prevent people from being physical active. First there are some personal barriers, accounting people's ability and motivation to exercise. Also, a lack of time, other (more important) responsibilities and a lack of knowledge are barriers which restrain people from being active. Secondly there also environmental barriers, conditions in our cities which limit the possibilities for physical activity. For example, a lack of bike- and pedestrian roads, lack of good quality public spaces, etc. (Frank & Engelke, 2001). Since, urban planners/designers will only have influence on the latter, this project will focus on the environmental barriers.

To increase physical activity, public health researchers share the opinion that policies influencing health behaviour are less effective than adjustments in the built environment. However, there is little research done on the environmental barriers which have an impact on health and travel behaviour (Frank & Engelke, 2001).



More cars, due to increased road capacity and accessibility
> Less space for slow traffic



Attractiveness new motorized transport, in terms of costs and travel time
> More people will use AM
> Sub-urban development - car dependency



AM more time efficient than public transport
> Less active travels towards public transport



An increased traffic complexity, due to separated flows, pick-up points and new forms of travel
> Less accessibility for pedestrians and bicyclists

Image 9: Possible threats on health due to AM (own image)

Threat: automated mobility
It is calculated that in the Netherlands 10 percent more vehicle kilometres will be covering the main road network by 2023, compared to 2017. The travel time loss can increase in total by 35 percent (Kennisinstituut voor Mobiliteitsbeleid, 2018). On top of this, the introduction of automated mobility will provide car users with extra opportunities to work or relax in their cars. As a consequence, people are willing to travel longer, and the frequency of trips might increase (Stead et al., 2018). This can lead to more urban sprawl and an even bigger reliance on the car. The general idea is that automated vehicles lead to higher pressure on the road network. The increase in vehicle kilometres can be explained by a changing modality choice among users. Automated vehicles make mobility more accessible to a wider audience as a result of expected lower costs, with longer distances being covered. Leading to more and more vehicles driving around (Arcadis, 2018).

All in all, the introduction of automated mobility will have a big impact on our health and travel behaviour. Due to the attractiveness of the new motorized transport modes in terms of costs and travel time (value of time) and the opportunities to work or relax in their cars, the share of cycling and walking might decrease (Arcadis, 2018). Besides, it might enlarge the already existing problems of the

dominance of cars in streets and physical inactivity. Unlimited access of automated vehicles in the cities will have a big impact on active travels. Those are highly dependent on the conditions in which the automated vehicles are allowed to act in cities (Stead et al., 2018).

Impact of automated mobility on active transport might be for example a decrease of the use of public transport because automated mobility will be more time efficient, leading to less active travels towards the public transport stations. Besides, people do not have to walk to their car anymore if the automated vehicles can pick you up wherever you like, whenever you like. This pick-up and drop-off system will cover a lot of space, which leaves little or no space for pedestrians or cyclists. Also, it might be needed to separate roads to reduce disruption of the autonomous vehicle flow. This leads to less accessibility for pedestrians and cyclists (Stead et al., 2018).

Stead et al. (2018) states that careful management is needed to prevent the dominance of vehicles. Automated vehicles can only promote active travel when their access is restricted, and vehicles are shared. This is visualized in the diagram of image 10, see green box. Without this management of automated mobility active travel and accessibility will suffer, which leads to an increase of economic, social and environmental costs (Stead et al., 2018).

The threats of automated mobility are summed up in the blue box of image 9.

Role of the car

The car always had a prominent role in our cities. The introduction of automated mobility offers us the chance and opportunity to rethink the city and redesign mobility networks. A limited access of the autonomous vehicles is one of the main starting points for designing for a future with automated mobility.



Image 10: Management automated vehicles (Stead et al., 2018)

Context introduction

Since the largest part of our society lives in residential neighbourhoods, and in these areas is a high car dependency, this project will focus on residential neighbourhood. For the scope of this project Almere is chosen as location. Almere is located in the IJsselmeerpolders in the province of Flevoland. The IJselmeerpolders were mainly intended as agricultural land. However, after World War II it became clear that the rapidly growing population of Amsterdam in particular would have to be accommodated elsewhere. Two cities were designed in the polders Oostelijk Flevoland (Eastern Flevoland) and Zuidelijk Flevoland (Southern Flevoland). The city in Oostelijk Flevoland became Lelystad. The city in southern Flevoland was named Almere in the seventies, after the early medieval name of the Zuiderzee (Wikipedia, 2018a).

Long before the first inhabitants settled, the RIJP engineers (De Rijksdienst voor de IJsselmeerpolders) were already fantasizing about the companies that would settle in the new city. It was assumed that at least 90% of the inhabitants of Almere would work in their own city. However, this appeared to not be the case. The inhabitants of Almere generally remained loyal to their employer in the old city and commuted between their home and work. Although a lot of small and middle-sized companies settled in Almere, still the largest part of the inhabitants kept commuting to their work in another city (mainly Amsterdam). The people who started working in Almere commuted in the opposite direction, they lived in another city and worked in Almere (Canon van Almere, n.d.).

When an economic recession emerged in the early 1980s, the growth in the number of jobs in Almere for the first time lagged the growth of the labour force. Traffic jams between Almere and Amsterdam became a familiar image. However, many people were pleased with the first traffic jams in the Netherlands, because the traffic jam was a of sign progress. Nowadays traffic jams lead to a lot of frustration. De RIJP realized that small and medium-sized businesses, a prominent industry in Almere, could easily grow but also disappear easily. From that moment on, the RIJP tried to bring large companies and specific industries to Almere. That new policy paid off. Between 1990 and 1998 there was a 9% job growth in Almere compared to a 2% nationwide. Nevertheless, there was still no balance between living and working. Due to the rapid housing construction, the population continued to grow much faster than the number of jobs. This is still the case resulting in a lack of infrastructure and services in the city (Canon van Almere, n.d.).

Expansion of Dutch cities

After the Second World War there was a huge demand for housing in the Netherlands. During the post-war reconstruction many cities started expanding and huge residential suburban areas were built in only a couple of years. The ideas of clarity and transparency had a central role in that time. Mainly driven by the CIAM, the design has since then been based on a functional separation, on the one hand, and the composition of free-standing masses in the open space, on the other hand. The nineteenth-century street with continuous closed building blocks was rejected by the modern movement. The idea of light, air and space prevailed during this time (Heeling, Meyer, Westrik, Sauren, & Hoekstra, 2002).



Image 11: Modernism neighbourhood (Gemeente Amsterdam Stadsarchief, 1972)



Image 12: Cauliflower neighbourhood (Aerophotostock, 2014)

Traffic intensity

60000+ vehicles/day

20000-60000 vehicles/day

A8
74.000
vehicles/day

A10
51.100
vehicles/day

A5
26.700
vehicles/day

A10
76.900
vehicles/day

A9
63.300
vehicles/day

A4
81.500
vehicles/day

A2
91.200
vehicles/day

A1
104.300
vehicles/day

A6
40.300
vehicles/day

Modal split extern

Car	67 %
Public transport	32 %
Bike	1 %
Walking	0 %

Modal split intern

Car	38 %
Public transport	12 %
Bike	29 %
Walking	21 %

Commuting flows (x1000)
Region Almere-Lelystad

46 In — 65 Out

Living-workingbalans: –19000

2 — 2

22 — 6

31 — 23

3 — 8

4 — 10

1:250000

Traffic on roads

+60000 vehicles a day

20000-60000 vehicles a day

Image 13: Commuting flows Almere (own image, information from: TNO, NEO, VU, & Ecorys, 2018)

The open city that was created by the carefully placement of building blocks. Roads, water and green form a continuous public space. The broad green and water elements are no residual space, but an important structuring urban design element with an independent role. The buildings were assembled in strips and courts and could be low, medium or high-rise building blocks. The high-rise buildings serve as a landmark and consists of individual towers and strips as well as series of identical objects (Gemeente Amsterdam, n.d.-c). The idea prevailed that the city had to adapt to the car. Characteristic for the 1960s were the megastructures, architectural complexes with the size of a district and sometimes even a city (Ibelings, 1999).

From the 1960s on there was more and more critique on the large-scale projects from the modernism (Ibelings, 1999). For example, in 1971 the Amsterdam Federation of Housing Associations announced that high-rise buildings were no longer desired. There were a lot of examples where the ideas of the modernism did not work out as imagined, for example the Bijlmer (in Amsterdam South-East). New neighbourhoods had to have a new set-up with a mix of three to four floors flats, single-family homes and shopping centres (Gemeente Amsterdam, n.d.-c). Small-scale and hospitableness were the key words for urban design in the 1970s. The "woonerf" (English = slow-traffic residential area) made its appearance. Large roads structures made its way for a winding streets structures and where possible the car was banned (Ibelings, 1999). Buildings were arranged along alternating building lines along courts. Front doors are preferably located along slow traffic roads. There is a subtle interweaving of the slow traffic structures with green structures which are made accessible by walking paths. Due to the changing directions of building blocks, road structures and green structures, the building blocks often have no clear front- or backside (Gemeente Amsterdam, n.d.-c). This typology is to a large extend used in Almere.

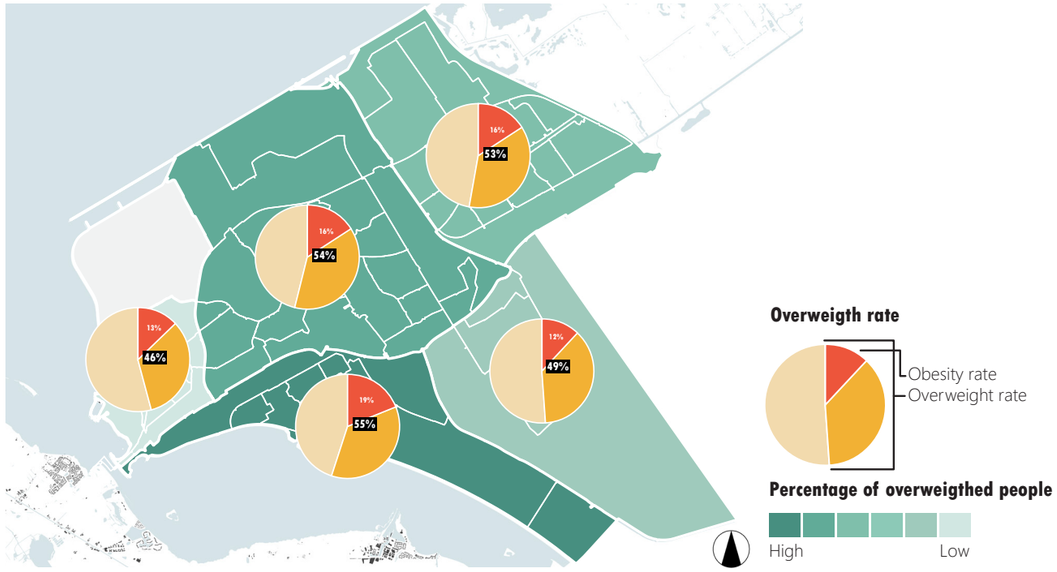


Image 14: Overweight and obesity Almere (own image, information from: RIVM, 2018)

Contradiction

Although the car was banned and slowed down in the new neighbourhood types, they still played a big role in the neighbourhoods. In Almere, large amounts of people were depended on their car for daily travel to their work. Which resulted in car-dominated neighbourhoods.

Almere - work

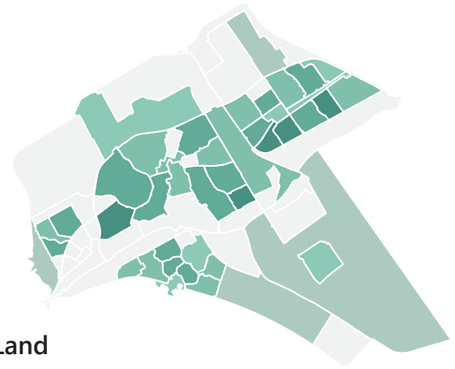
The live-work balance in Almere is less in balance than in other Dutch cities with a comparable size. Employment opportunities counted in 2017 65,100 jobs, while the workforce was 104,000 people (CBS, 2017). With 60,000 people the outgoing commuting flow is almost 3 times larger than the incoming flow. This leads to a large number of trips across the municipal boundaries. 32% of these trips are done by public transport, and in peak hours this can rise up to 50%. This public transport rate is quite high compared to other cities of a comparable size. 67% of the external trips take place by car. Only 1% of the trips across the municipal boundaries take place by bicycle. This is mainly due to the lack of jobs in a radius of 5 kilometres around Almere. The distances become too big to cycle (Gemeente Almere, 2012). Within the municipal boundaries, 12% of local trips take place by public transport. This is two to three times more than in other large municipalities. The car is used in 38% of local journeys, which is more than average. 29% of local trips take place by bicycle/ moped. This is a relatively low percentage compared to other municipalities with more than 100,000 inhabitants (Gemeente Almere, 2012).

Almere - health

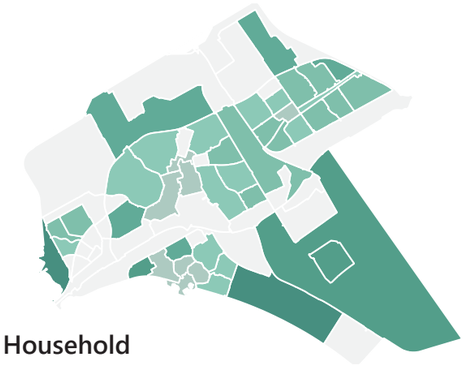
The percentage of adults with overweight is lowest in the GGD region of Amsterdam (40.7%). The percentage of overweight adults is highest in the GGD regions of Drenthe, South Limburg, Twente and Flevoland. Over 52% of people living in these regions are overweight (Flevoland: 52.4%). This means that these people have a BMI of 25 or higher. In the Netherlands, on average 48.9% of adults aged 19 and older are overweight. In Almere itself 51.4% of the inhabitants is overweight of which 15.2% has obesity. In the district Almere Haven this rate is respectively 55%-19% and in Almere Stad this is respectively 54%-16%, these two areas have the highest rates in Almere. Only 45% of the inhabitants in Almere achieve the activity guidelines (RIVM, 2018). By stimulating physical activity, in these two areas can be achieved the most.

However, to decide the specific neighbourhoods to choose, also some other factors are taken into account. This are factors concerning car use, traffic issues, emission and accessibility to some facilities (see image 15 and 16). The accessibility will affect the choice for different transport modes, and mainly the choice for active or not active transportation modes. To see which neighbourhoods will be affected the most (in positive or negative way) per factor

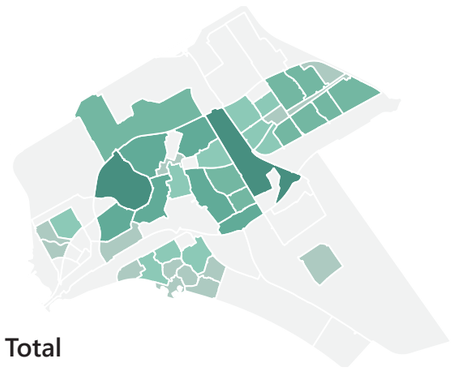
Cars per...



Land

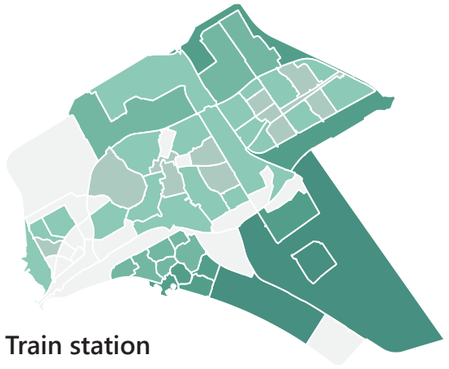


Household

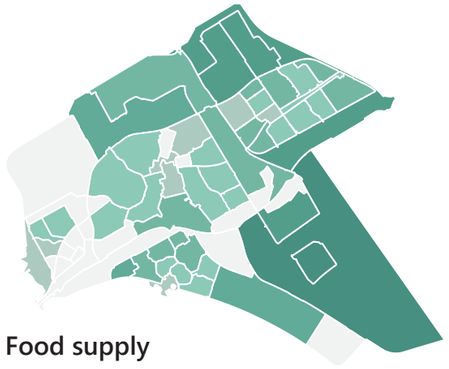


Total

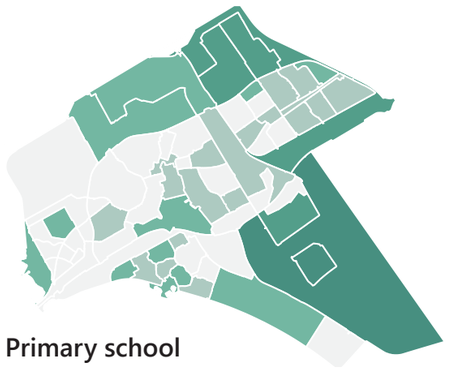
Bad access to...



Train station

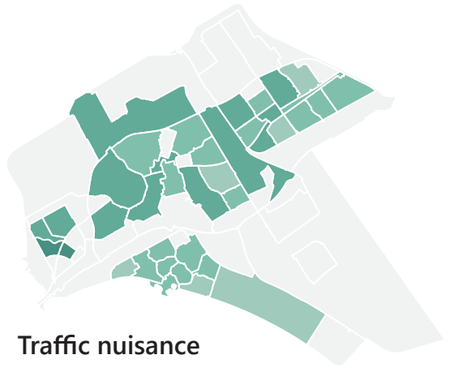


Food supply

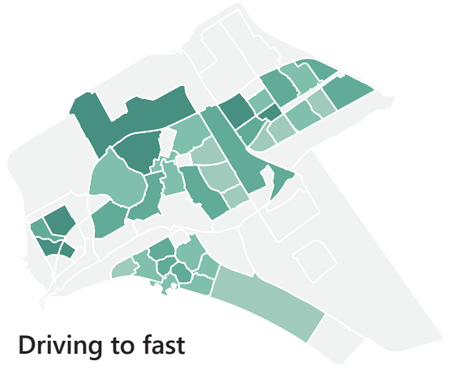


Primary school

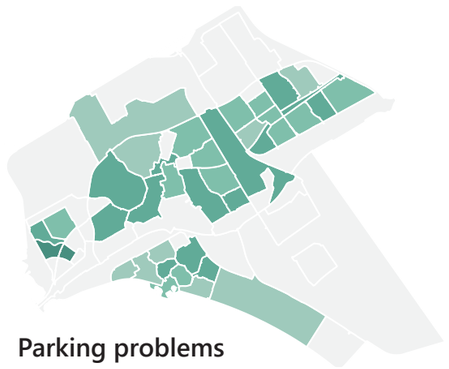
Traffic



Traffic nuisance

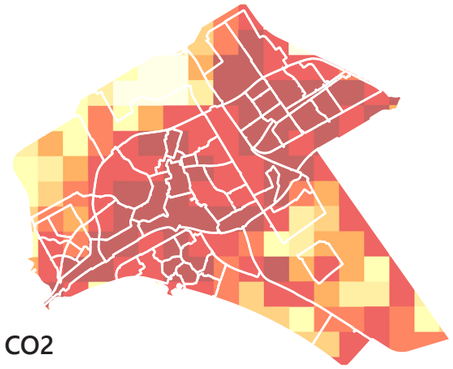


Driving to fast

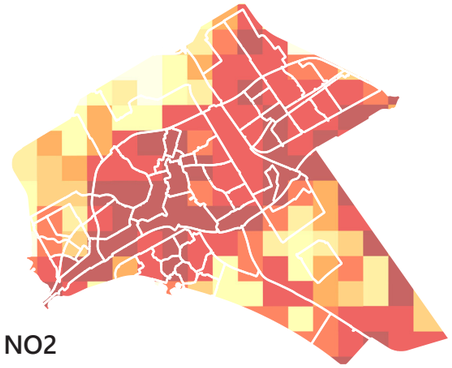


Parking problems

Emission



CO2



NO2



Noise nuisance

Percentage cars per..

High Low

Percentage bad acces to..

High Low

Percentage traffic

High Low

Percentage emission

High Low

Image 15: Factors neighbourhood selection
(own image, information from: CBS, 2017; Gemeente Almere, O&S, Veiligheidsmonitor-Wijkpeiling Almere, 2017)

10 neighbourhoods are listed where the impact might be the biggest. Concerning the amount of cars per land, household or total, Almere Stad and Almere Buiten score the highest. Also looking into the traffic issues, the two districts score relatively high. There are for example a lot of parking problems in some neighbourhoods of the districts. Therefore, I selected the two neighbourhoods Filmwijk and Danswijk in the district Almere Stad. I selected those two because the impact of automated mobility might be big here, concerning both the mobility patterns and the activity patterns. The activity patterns are again linked to the high amount of inhabitants who are overweight. Considering the accessibility to facilities especially the district Almere Haven scores low (and some rural districts on the edge of the city). This area in the south of Almere is a bit more isolated and is located on the other site of the A6. There is a small centre with some shops, however not all services and facilities are nearby. Inhabitants living in this district are more dependent on their car, compared to other parts of the city. As well as in Almere Stad, Almere Haven scores high on overweight and obesity. Because the people living in Almere Haven are highly dependent on their car, for work, facilities and recreational purposes, the following neighbourhoods are selected: De Wierden, De Hoven and De Werven.

The two neighbourhoods in Almere Stad have a better accessibility to public transport, compared to Almere Haven. This main difference might result into two different visions and strategies, considering a automated future, for the different districts (Allecijfers.nl, 2018; RIVM, 2018).

Almere intern

Car	38%
Public transport	12%
Biking	29%
Walking	21%

Almere extern

Car	67%
Public transport	32%
Biking	1%
Walking	0%

Almere total (2018)

Car	50%
Train	14%
Bus/tram/metro	5%
Biking	18%
Walking	14%

Cars per ...

Land
Danswijk
Eilandenbuurt
Literatuurwijk
Faunabuurt
Bloemenbuurt
Molenbuurt
Landgoederenbuurt
Muziekwijk
Stedenwijk
Waterwijk

Household
De Velden
Noorderplassen
Sieradenbuurt
Buitenvaart
De Gouwen
Literatuurwijk
Danswijk
Verzetwijk
Tussen de Vaart
Oostvaarderwijk

Total
Muziekwijk
Tussen de Vaarten
Literatuurwijk
Filmwijk
Veluwsekant
Stedenwijk
Kruidenwijk
Waterwijk
Noorderplassen
Stripheldenbuurt

Modal split (Almere)

Inhabitants in 15 min cycling at train station

Almere Buiten	73%
Almere Centrum	75%
Almere Muziekwijk	75%
Almere Parkwijk	88%
Almere Poort	33%

Inhabitants in 10 min walking at train station

Almere Buiten	73%
Almere Centrum	75%
Almere Muziekwijk	75%
Almere Parkwijk	88%
Almere Poort	33%

Working place in 15 min cycling from train station

Almere Buiten	75%
Almere Centrum	75%
Almere Muziekwijk	84%
Almere Parkwijk	73%
Almere Poort	28%

Working place in 10 min walking from train station

Almere Buiten	75%
Almere Centrum	75%
Almere Muziekwijk	84%
Almere Parkwijk	73%
Almere Poort	28%

Bad access to ...

Train station
De Meenten
De Grienden
De Werven
Centrum Almere-Haven
De Hoven
De Marken
De Wierden
De Velden
De Steiger
De Gouwen

Foodsupply
Noorderplassen
De Velden
De Steiger
Stripheldenbuurt
De Marken
De Gouwen
Faunabuurt
Sieradenbuurt
Poldervlak
De Wierden

Primary school
De Velden
Sieradenbuurt
Centrum Almere Haven
Homeruskwartier
De Werven
De Gouwen
Noorderplassen
Poldervlak
De Steiger
Verzetwijk

Traffic

Traffic nuisance
Europakwartier
Tussen de Vaarten
Columbuskwartier
Centrum Almere Buiten
Filmwijk
Bouwmeesterbuurt
Literatuurwijk
Stedenwijk
Homeruskwartier
Noorderplassen

Driving to fast
Europakwartier
Centrum Almere Buiten
Homeruskwartier
Noorderplassen
Tussen de Vaarten
Kruidenwijk
Literatuurwijk
Columbuskwartier
Seizoenenbuurt
Stripheldenbuurt

Parking problems
Europakwartier
Faunabuurt
Danswijk
Staatsliedenwijk
Filmwijk
Tussen de Vaarten
De Grienden
Eilandenbuurt/Indischebuurt
De Marken
Columbuskwartier

Emission

CO2
Centrum Almere Stad
Stedenwijk
Filmwijk
Gooisekant
De Werven
De Hoven
Molenbuurt
Centrum Almere Buiten
Regenboogbuurt
Faunabuurt

NO2
Centrum Almere Stad
Stedenwijk
Gooisekant
Markerkant
Literatuurwijk
De Werven
Faunawijk
Molenbuurt
Veluwsekant
De Gouwen

Noise pollution
De Steiger
De Gouwen
Gooisekant
Hollandsekant
Kruidenwijk
Markerkant
Molenbuurt
Landgoederenbuurt
Faunabuurt
Bouwmeestersbuurt

Image 16: Factors neighbourhood selection
(own image, information from: Steneker, de Haan, & Klein-Lenderink, 2018)

Neighbourhood introduction

Demographics
In the table of image 17 is the demographical data shown of the fife neighbourhoods in the 2 districts. Filmwijk counts 10,515 inhabitants, this is the biggest selected neighbourhood. In Almere Stad does Danswijk count 5,840 inhabitants. In Almere Haven, De Wierden, De Hoven and De Werven count respectively 3,769, 2,435 and 2,776 inhabitants. The city of Almere has in total 203,990 inhabitants and will grow till 2040 with 78,000 inhabitants and 60,000 houses compared to 2010 (Provincie Noord-Holland, 2017).

In Filmwijk the percentage of young children is slightly lower than the average in Almere. The percentage of inhabitants between the 44 and 65 years old is higher than in the rest of Almere. Both in Filmwijk and in Danswijk is the share of inhabitants who are between the 15 and 24 years old bigger compared to the average in Almere. The amount of elderly (65+) is lower than in the rest of Almere. In Almere Haven the neighbourhoods have a relatively high amount of elderly (65+). The group of people between the 44 and 65 years old is somewhat smaller and the rest of the groups are comparable to the average in Almere.

Striking is that all neighbourhoods have a higher percentage of inhabitants with a lower education level. This might be explained by the fact that there are more affordable houses and more social housing in these areas.
All neighbourhoods have more or less the same number of inhabitants with a western background. In Danswijk live relatively more non-western migrants than in the rest if Almere. The largest part is represented by Surinamese people (CBS, 2017).

The income in the three neighbourhoods in Almere Haven is lower than average

	Inhabitants	Men/Women (%)	Age (%) 0-14	15-24	25-44	44-64	65+	Low educational levels (%)	Migrant western (%)	Migrant non-western (%)	Income (x €1000)	Income recievers (%)	Amount of businesses	Avarage households size	Cars per household
Almere total	203.990	50/50	19	13	28	29	11	23,6	10	31	23,5	72	15.290	2,4	-
Almere Stad															
Filmwijk	10.515	51/49	16	16	24	33	11	41	12	30	24,7	76	590	2,3	0,9
Danswijk	5.840	50/50	20	15	27	31	6	41	10	38	20,8	72	295	2,6	1,0
Almeren Haven	3.760	46/54	21	11	27	25	16	36	10	33	17,9	69	125	2,1	0,7
De Wierden	2.435	48/52	20	10	29	25	16	36	9	31	19,7	74	100	2,1	0,7
De Hoven	2.775	49/51	16	11	29	26	18	36	10	26	19,1	72	135	2,0	0,8
De Werven															

Image 17: Demographics Almere Haven & Almere Stad (own image, data from: CBS, 2017)

of Almere. In Filmwijk and Danswijk it is comparable with the average. In both Filmwijk and Danswijk are more businesses settled than in Almere Haven.

In Almere Stad the average size of households is comparable with the average of the municipality. In Almere Haven the size of the households is somewhat smaller than the average. Also, the number of cars per household in Almere Haven is lower than in Almere Stad.

Housing stock
Filmwijk counts 4,352 homes, of which one third is social housing. The plans for building the site to the east of Almere-Centrum arose in the eighties. By 1996 mainly all houses were finished. The average value of the houses in Filmwijk is €187,000. 71% of the houses are single family houses, 29% of the stock are multi-family houses. 98% of the housing stock is inhabited, only 2% is vacant (CBS, 2017).

Danswijk has 2,122 homes, of which 23% is social housing. As well as Filmwijk, Danswijk is finished by the end of the 1990s. The average value of the houses in Danswijk is €163,000, somewhat lower than in Filmwijk. 83% of the houses are single family houses, 17% of the stock are multi-family houses. 99% of the housing stock is inhabited, only 1% is vacant (CBS, 2017).

De Wierden, in Almere Haven, has 1617 homes. 67 % of the number of houses is social housing. Almere Haven was the first part which was built of Almere, De Wierden was built between 1980 and 1990. The average value of the houses in De Wierden is €136,000, quite some lower than in the two neighbourhoods of Almere Stad. 60% of the houses are single family houses, 40% of the stock are multi-family houses. 99% of the housing stock is inhabited, only 1% is vacant (CBS, 2017).

De Hoven counts 1130 homes, of which 55% is social housing. De Hoven was built between 1975 and 1980. The average value of the houses in De Hoven is €148,000, which is somewhat higher than the houses in De Wierden. 49% of the houses are single family houses, 51% of the stock are multi-family houses. This share of multi-family houses is the highest of the selected neighbourhoods. 98% of the housing stock is inhabited, only 2% is vacant (CBS, 2017).

De Werven counts 1325 houses, of which 51% is social housing. De Werven was built between 1975 and 1980. The average value of the houses in De Hoven is €141,000, which is somewhat higher than the houses in De Wierden. 65% of the houses are single family houses, 35% of the stock are multi-family houses. 98% of the housing stock is inhabited, only 2% is vacant (CBS, 2017).

Health
In Almere Stad and Almere Haven is the experienced health respectively 69% and 72%, this is lower than the average of the city of Almere, which is 75%. Also, both neighbourhoods score higher on loneliness (both 49% on loneliness and 13% on severe loneliness). In Almere Haven live more people who are physical disordered, namely 13% compared to an average of 8,6%. In Almere itself 51,4% of the inhabitants is overweight of which 15,2% has obesity. In Almere Haven this rate of inhabitants who are overweight is 55%, 19% has obesity. In Almere Stad this balance is 54%, compared to 16%. These two districts have the highest rates in Almere. Only 45% of the inhabitants in Almere achieve the activity guidelines (RIVM, 2018). Moderate forms of physical activity, like walking and bicycling, can already contribute to a healthier lifestyle. It can reduce non-

communicable diseases like obesity, heart diseases, diabetes (type 1), some cancers, anxiety, depression, and so on (Frank & Engelke, 2001).

In Almere, 19% of children and young people up to 19 years of age are (seriously) overweight. This has serious consequences for their health - in the short and long term. That is why the municipality focuses on the prevention and reduction of overweight children.

In order to grow up healthy, children need the input and drive from everyone. Especially those of themselves, their parents and their close environment. But also, that of professionals in education, healthcare, welfare and neighbourhood organizations, sports clubs and companies. With the Aanpak Gezond Gewicht Almere (English = Healthy Weight Approach Almere), the municipality of Almere is working together with other parties on a healthy weight for the youth of Almere; from collective prevention to the care for children up to 12 years (Gemeente Almere, n.d.).

However, it is necessary, not only to focus on children but also focus on the lifestyles of adults and elderly, where also some big problems occur. Besides, the lifestyles of parents also have a big impact on the lifestyles of children. Patterns of physical activity of someone's life is established in their childhood (Barton & Tsourou, 2000). How do we make sure that people live healthy when new technologies encourage us to do the opposite? We can order our groceries online, we have contact with each other via social media, we basically do not have to go out anymore. When automated vehicles are introduced, we even do not need to walk to our car anymore. What will be the impact of automated mobility on our physical activity patterns, and hence the health of the whole society? The whole society as a whole should benefit from automated mobility. To do this it is necessary to address both the general population, but also the vulnerable groups. To do this social inclusiveness needs to be addressed (European Commission, 2018).

Land development patterns

The automated mobility might not only influence the society but also the land development patterns and consequently the commuting patterns. The time usually spent by driving in the car can now be spent by doing something else. People are willing to travel longer, and the frequency of the trips might increase. Besides, due to more efficient driving the road capacity increases, this leads almost always to more vehicles on the roads (comparable with adding more roads nowadays). More and more vehicles will cover the roads.

Image 18 shows the development plans for housing until 2040, with quite some development in and around Almere. Probably sub-urban development will increase due to the ease of driving with automated vehicles. Urban regions will be extended across regions and territories, this will lead to a horizontal metropolis (Viganò, Cavalieri, & Barcelloni Corte, 2018). This leads to a change in commuting flows. People will travel longer distances to go to their work. Since there are a lot of job possibilities in and around Amsterdam (Schiphol) more people will come from outside the AMA to work. An increased flow of incoming daily travellers will lead to even more congestion on the roads in and around Amsterdam (see red arrows in image 19). In this way the car dependency increases, which puts physical activity patterns under pressure and increases the amount of cars in streets and on roads.

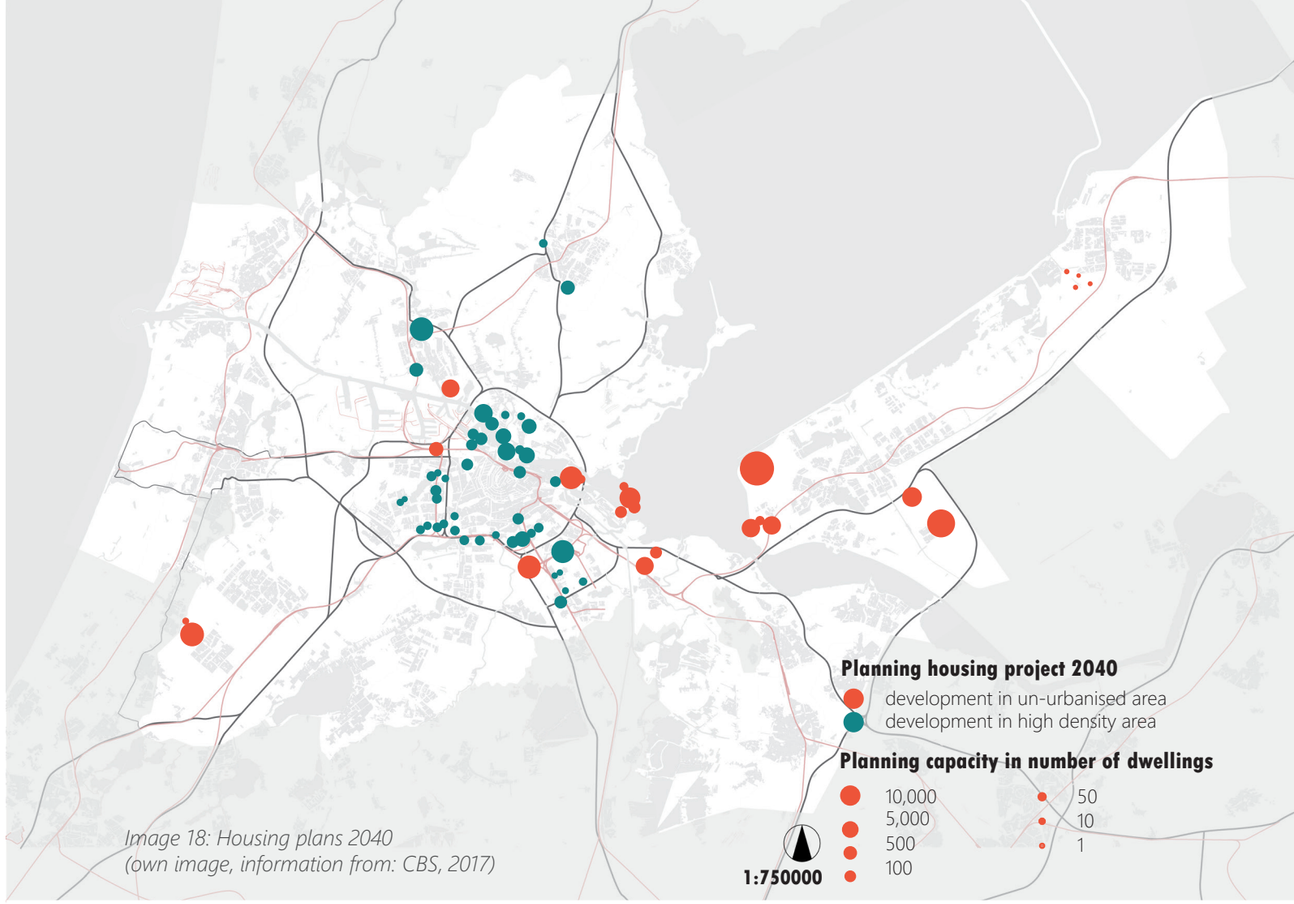


Image 18: Housing plans 2040
(own image, information from: CBS, 2017)

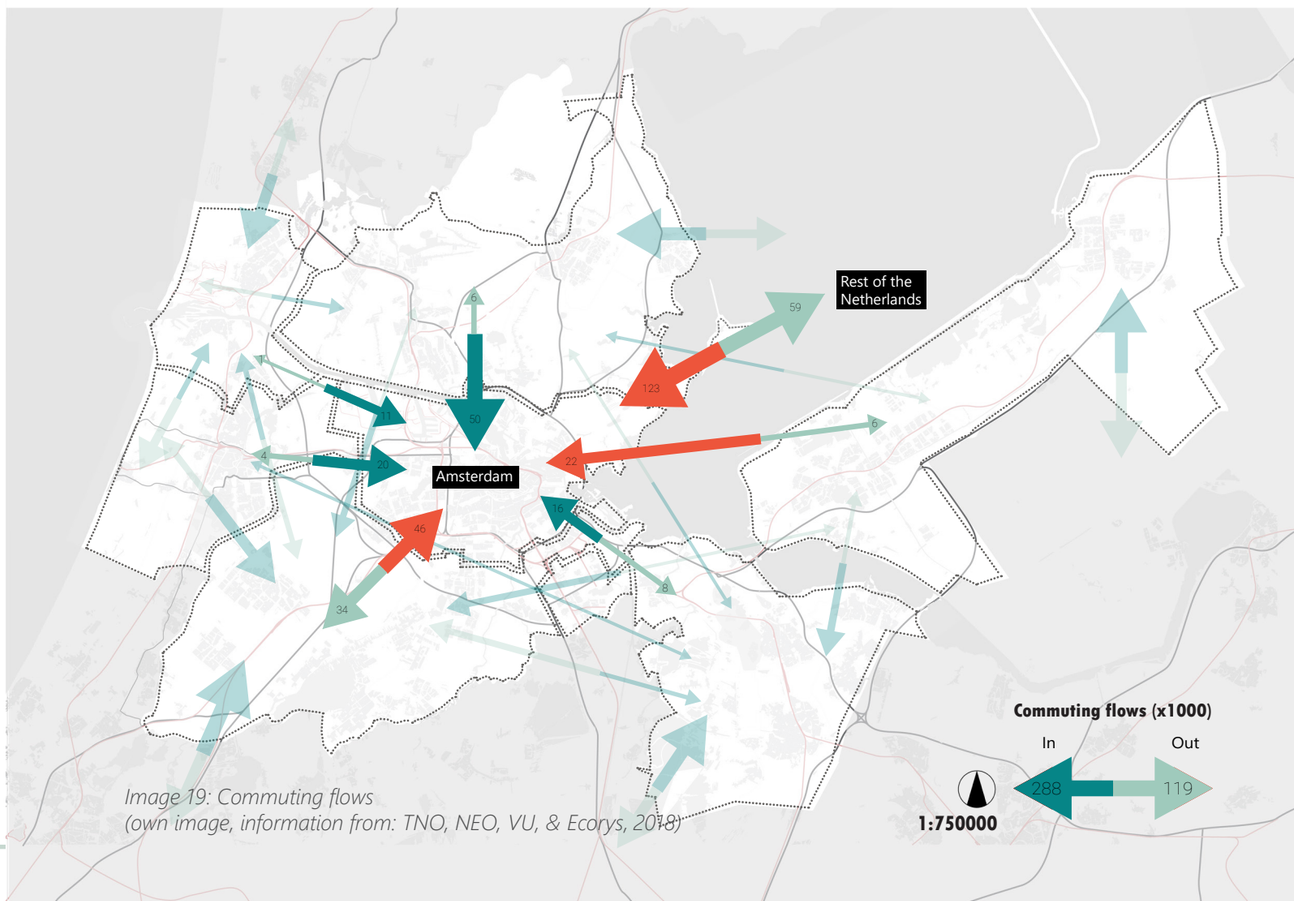


Image 19: Commuting flows
(own image, information from: TNO, NEO, VU, & Ecorys, 2018)

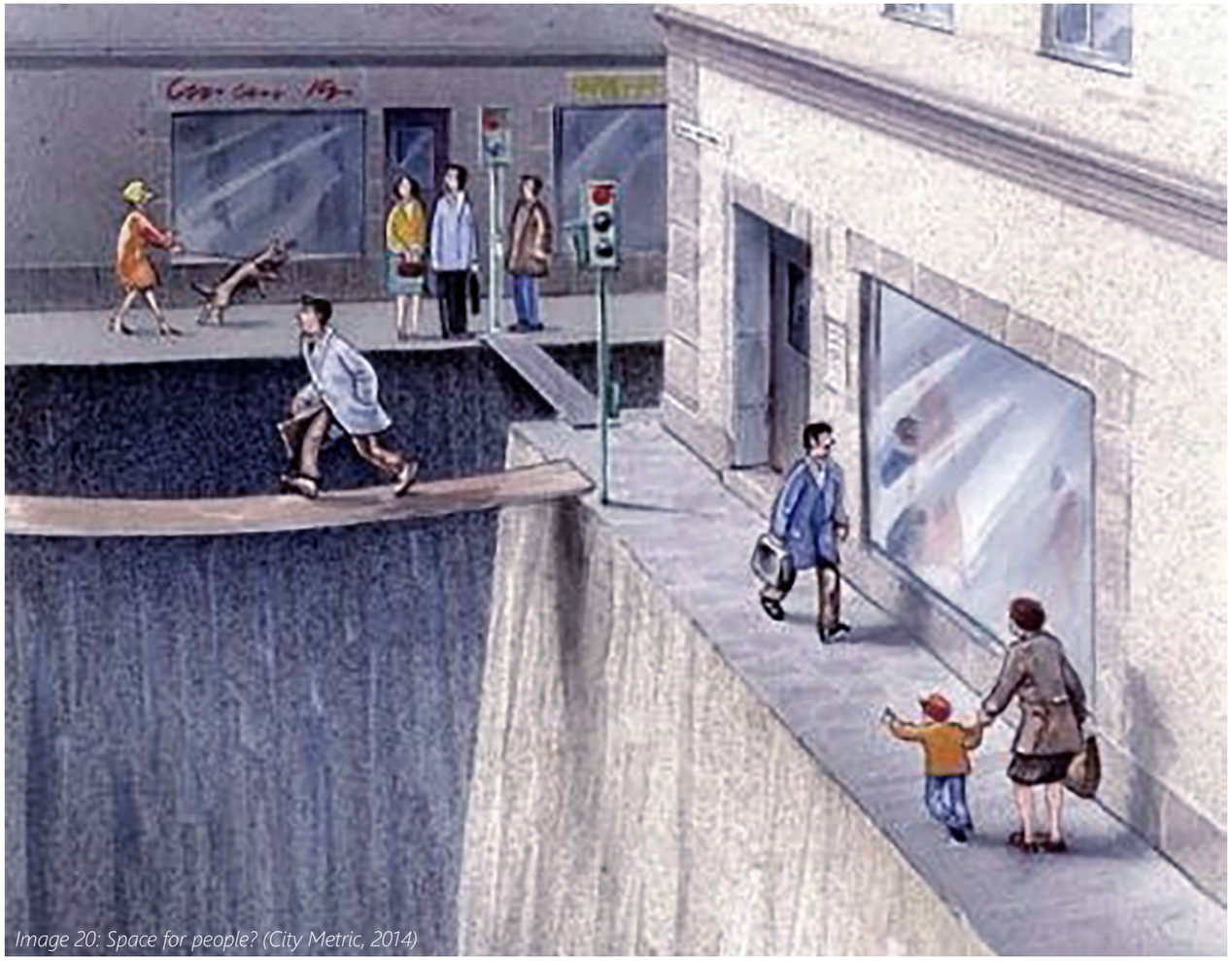
Problem statement

Growing mobility
Since the introduction of the car, our mobility is continuously growing (Kennisinstituut voor Mobiliteitsbeleid, 2018). Which leads to highly polluted areas, affecting urban health. Besides, the growing mobility results in a higher number of traffic accidents on the main road network (NU.nl, 2017).

Not only growing mobility, but also the urban development of our cities will have an influence on urban health. Suburban development causes a population level reliance on car use every day. This imposed reliance causes low physical activity levels in a lot of residential neighbourhoods among many industrialized countries (Badland & Schofield, 2005).

Physical inactivity, caused by dominance of the car in cities, the car dependency and infrastructural barriers in the city, can result in major health risks, especially in industrialized countries (Badland & Schofield, 2005). In Almere itself 51.4% of the inhabitants is overweight of which 15.2% has obesity. In the district Almere Haven this rate is respectively 55%-19% and in Almere Stad this is respectively 54%-16%, these two areas have the highest rates in Almere. Only 45% of the inhabitants in Almere achieve the activity guidelines (RIVM, 2018). Active forms of travelling, like walking and bicycling can contribute to a healthier lifestyle (Frank & Engelke, 2001). Still, there is a lack of research done into the influence of the physical environment on urban health (Koohsari et al., 2015).

Threat
The introduction of automated mobility will provide car users with new possibilities to do while traveling. As a consequence, people are willing to travel longer, and the frequency of trips might increase (Stead et al., 2018). This can lead to more urban sprawl and an even bigger reliance on the car. The general idea is that automated vehicles lead to higher pressure on the road network. The increase in vehicle kilometres can be explained by a changing modality choice among users. Automated vehicles make mobility more accessible to a wider audience as a result of expected lower costs, with longer distance s being covered. Leading to more and more vehicles driving around (Arcadis, 2018). Due to the attractiveness of the new motorized transport modes in terms of costs and travel time (value of time), the share of cycling and walking can decrease (Arcadis, 2018).


Image 20: Space for people? (City Metric, 2014)

The impact of automated mobility on active transport might decrease the use of public transport because automated mobility will be more time efficient, leading to less active travels towards the public transport stations. Besides, people do not have to walk to their car anymore if the automated vehicles can pick you up wherever you like, whenever you like. This pick-up and drop-off system will cover a lot of space, which leaves little or no space for pedestrians or cyclists. Also, it might be needed to separate roads to reduce disruption of the autonomous vehicle flow. This leads to less accessibility for pedestrians and cyclists (Stead et al., 2018).

Without management of the automated mobility, active travel and slow traffic accessibility will suffer, resulting in many health risks (Stead, 2018).

Summing up, the ever-growing mobility puts urban health at risk. On top of this, the introduction of automated mobility is posing a threat on various facets of urban health (personal lifestyles, accessibility, etc.), especially in residential neighbourhoods (because of the high car dependency).

The challenge is to improve urban health in residential neighbourhood while our mobility use is growing and automated mobility is introduced and poses a threat on urban health.

Hypothesis

After the industrialisation
The growth of many European cities in the nineteenth and twentieth centuries was closely related to the rise of the industrial economy. The development of this industrial society has been accompanied by increasing trust in a development of the sciences based on rational, verifiable knowledge. This is closely related to the rise of the enlightenment, supported by the belief in the ability to understand, influence and change the world through human reason. The close connection between the enlightenment and modern natural sciences led to a strong belief in the possibility of the 'recreation of the world'. With the invention of the steam engine and electricity, which led to massive industrial production and large-scale networks of railways, waterways and motorways, the world was indeed to a large extent recreated (Meyer, Westrik, & Hoekstra, 2014).

However, not only the city itself is subject to change. An independent discipline has emerged that focuses on the spatial development of the city, urban planning. This development was to a large extent a reaction to the deplorable state of cities during the first phase of industrialization. All over Europe and America many cases were reported that there was a serious public health threat: not only the smell, pollution and noise that the factory complexes produced, but also the miserable conditions in which countless workers were forced to live. This was the reason for the establishment of health committees. These committees developed the first proposals for the construction of sewers and a drinking water supply and the improvement of the housing situation for a large part of the population (Meyer et al., 2014).

Cities grew spectacularly, in the beginning of the twentieth century Amsterdam, for example, grew with ten thousand inhabitants per year. This growth not only led to a considerable densification of the existing city centres, but also to the first expansion neighbourhoods. Traffic and transport changed considerably and, in many cases, led to large-scale transformations. Traffic and transport between and in cities were dominated by ships and waterways until the middle of the nineteenth century. Due to the introduction of the railways and later the car, the traffic and transport industry changed radically. Canals, ports and waterways were filled up, to accommodate stations, railways and motorways. Usually these projects were combined with the construction of sewers and other underground infrastructure (Meyer et al., 2014).

The need to improve the living conditions and steer these developments, was the main reason for the development of urban planning as a separate, professional and scientific discipline.

The designation of special areas for industry and the separation of industrial and residential areas became one of the most important goals in urban planning during that time. Due to the pollution and the noise of factory complexes, the principle of segregation of functions became dominant in the modern urban development of the twentieth century. In addition to the industrial areas for the production, the residential areas of the city should be areas of re-production, where, besides eating and sleeping, there was also room for relaxation, sport, entertainment, education and culture (Meyer et al., 2014).

In the last decades of the twentieth century the era of ever-growing industrial production came to an end in many Western countries. Due to automation the industrial production has changed considerably, but a large part has also moved to low-wage countries. When cities switched from an industrial to a post-industrial economy, there was an increasing group of residents who developed new lifestyles. There was an increased prosperity, the average size of households declined, while the demand for a larger living space has increased at the same time. The mobility has increased considerably. While car ownership was still a luxury in the mid-twentieth century, in the Netherlands every two inhabitants had a car in the beginning of the twenty-first century. For many people it is no longer necessary to live within walking or biking distance from their work. This is reinforced by the rise of digital communication. This led to a change in requirements that are imposed on the urban environment (Meyer et al., 2014).

The role of the car and bicycle over the years
Until the 1920s, the bicycle played a prominent role in all European cities. From the 1920s, public transport became one of the biggest competitors of the bicycle, however the bicycle remained the cheapest alternative. On top of this the urban structure was often not compatible for public transport and the car. This in combination with the compactness and the flat landscape led to a 'perfect storm' for the bicycle (de Bont, Distelbrink, & van Kessel, 2017).

To illustrate the city of Amsterdam is taken as an example. With the implementation of the General Expansion Plan (AUP) of Van Eesteren, Amsterdam extended with monofunctional residential and working neighbourhoods. The idea of segregation of functions created large distances within the city. Although the neighbourhoods were self-sufficient and were set up as 'health machines', with lots of light, air and space, large numbers of inactive drivers and tram passengers were the result. The cycling infrastructure is often in perfect order, but the distances between living, shopping and working were often (too) big. The car became normative, the expansion areas were optimally accessible from the highways. Within the residential areas the car got all the space with comfortable access routes and lots of parking possibilities. Separation of cars and bicycles was the prevailing philosophy, especially to guarantee the flow of cars (de Bont et al., 2017).

From designing against infectious diseases to designing against chronic diseases
Infectious diseases formed the greatest health threats in the 19th and beginning of the 20th century. To fight this, functions in the city were separated. Nowadays, this causes low physical activity levels. Many deaths are caused by chronic diseases these days, often triggered by physical inactivity (due to convenience of the use of the car in stead of using active forms of travelling). A task for urban designers and planners is to identify and deploy the physical interventions in urban areas to fight chronic diseases (NYC, 2010).

One of the main problems is that physical activity is designed out of our daily routines. Manual labour has been converted to sedentary jobs, cars have replaced active

forms of travelling, and stair climbing routines now replaced by escalators and elevators. Active leisure is replaced by the television, computer and video games, especially among children. With the introduction of automated mobility traveling might be more comfortable and easier than ever. Physical activity has been made difficult to achieve by the design of our streets, neighbourhoods, and cities. This results in an increased reliance on external sources of energy. On top of this the external sources can have a negative impact on our environment, but also on ourselfs. We do not exploit our own physical energy anymore (NYC, 2010).

Our society is rapidly digitalizing, offering services instead of owning products is central. Sustainability, traffic safety and innovation are central in the development here (Kennisinstituut voor Mobiliteitsbeleid, 2015). The increasing ease and comfort of the self-driving car, the figurehead of technological development, has a major impact on society and cities. New technologies offer opportunities, but also threats. Does digitalization, the convenience and comfort of the car lead to increasing pressure on our physical activity patterns, because it makes active travel unnecessary? Or can it help us to stimulate physical activity, by the innovation of new mobility and activity patterns?

Change - a new chance?
In the nineteenth century the rise of public transport and later the car was mainly driven by industrialization and was the figurehead of progress. After a few models of steam cars, the history of the car has its peak when the combustion engine was put on the market



Image 21: Perfect storm bicycle - Amsterdam (National Geographic, 1930)

in 1855 by Carl Benz (Orion, 2018). The advantages of this engine were mainly a lower weight and less fuel consumption for more power. The advance of this type of engine could no longer be stopped (Wikipedia, 2018b). In 1903 it was decided that the postal service could function more quickly when it started to use cars instead of the more old-fashioned train. The acceptance and popularity of the car grew (IsGeschiedenis, nd.).

Since 1945, car ownership in the Netherlands has increased explosively. In 1950 there were about 20 cars per 1000 inhabitants, in 1980 this was around 325 and in 2010 even 462 (Meyer et al., 2014).

Where the rise of industry and mobility for the general public, in the nineteenth century, had a negative impact on the health of society (pollution, physical inactivity due to larger distances and convenience, infectious diseases, etc.), new technologies might be a catalyst for health.

A new chance? New technologies offer all kinds of opportunities to develop a mobility system in which everyone can participate. Caring for the welfare of residents and visitors and providing attractive places for activities can contribute to the liveability of the region. With the help of new techniques cities will be more accessible. In addition, because we can always be online, we can work anywhere or communicate with others. This means that travel time also becomes a form of accommodation, resulting in less stress and more productivity during traveling time (Stadsregio Amsterdam, 2016).

Due to the introduction of automated mobility, with their additional opportunities, the car can fulfil a new role in the city.

In this project the hypothesis is: The implementation of automated mobility can contribute to improving urban health in residential neighbourhoods.

(New) Role of the car

In image 22 is a time line shown of the role of the car in the city. The role of the car in our life and city changed over the years. While car ownership was still a luxury in the mid-twentieth century, in the Netherlands every two inhabitants own a car in the beginning of the twenty-first century (Meyer et al., 2014).

When the car was introduced cities where not designed for cars, they had to be fitted into the existing fabric. The polluting factories in the city led to the idea of function separation, this became a prevailing idea. However, this created large distances within cities which were to big to cover by active travel.

With the idea of improving living environments garden cities were introduced. In satellite cities, workers' houses were situated in a village-like urban structures with relatively large amounts of greenery. There was a good connection, mainly by public transport with the central city. However, the small scale of the satellite cities caused problems. The rise of the car was not anticipated, which resulted in many parking problems (Gemeente Amsterdam. (n.d.-c).

After the Second World War there was a huge demand for housing in the Netherlands. During the post-war reconstruction many cities started expanding and huge residential suburban areas were built in only a couple of years. The car played a central role in this reconstruction era and was a symbol for progress. The car got all the space it needed in the city. The city had to adapt to the car (Ibelings, 1999).

As a reaction to the large-scale urban development, the woonerven were introduced in the 1970s. Large roads structures made its way for a winding streets structures and where possible the car was banned. Buildings were arranged along alternating building lines along courts. Front doors are preferably located along slow traffic roads. Small scale and hospitable urban areas were central ideas (Gemeente Amsterdam. (n.d.-c).

As a reaction the urban plans were leading in the following period. Because, the woonerven were too confusing to move through. Clear structures and urban elements were used to create overview and hierarchy. Clear and straight connections guided cars through the neighbourhoods (Gemeente Amsterdam. (n.d.-c).

Vinex locations were designated for housing to accommodate the growing population. The basic principles of the vinex locations are: location close to existing centers, limiting the vacancy in cities and the protection of open areas. Around this time, developers had to include parking spaces in the development of projects (Gemeente Amsterdam. (n.d.-c).

There is now also a lot of private commissioning in Almere. An organic form of urban design that provides a framework of public spaces, in which private clients are given the freedom to give their own interpretation to a project (Berg & Franke, 2007).

In all these years the role of the car in the city did not contribute to the urban health, on the contrary. How to use the changes in mobility to improve urban health will be one of the main questions in this project. The introduction of automated mobility offers us the chance and opportunity to rethink the city and redesign mobility networks. What should be the new role of the car (AM), with the introduction of automated mobility?

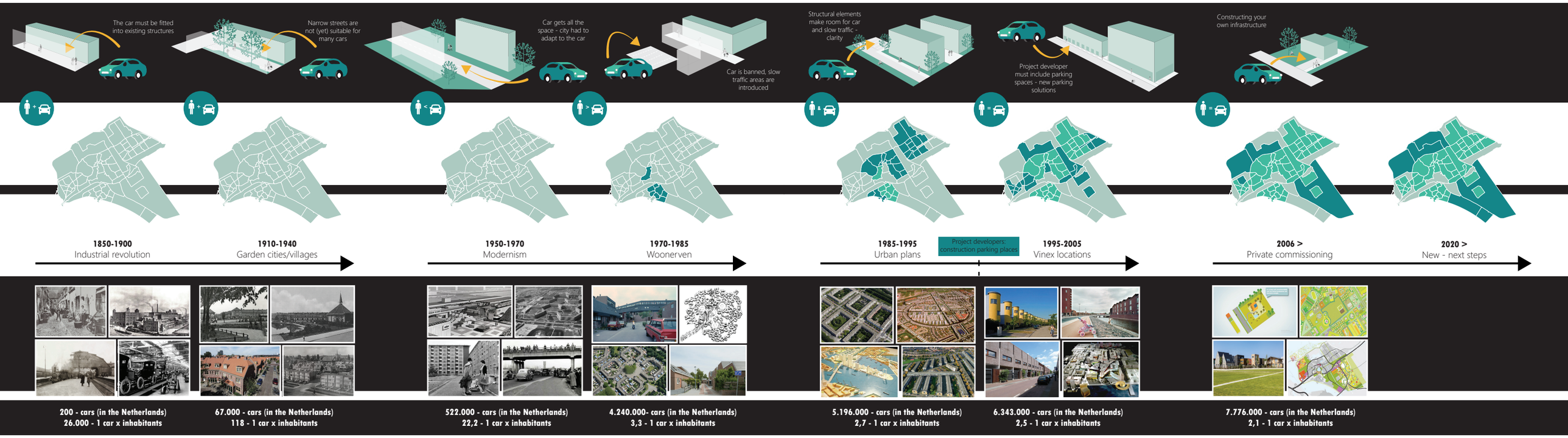


Image 22: Time line role of the car (own image: information from BOVAG-RAI Mobiliteit, 2012)

Aim

This project is dealing with two knowledge gaps. First, the lack of knowledge of the influences of the physical environment on urban health (Koohsari et al., 2015). There is not enough research done which describes 'how much' and 'what types' of infrastructure is requested to support health. It is needed to develop a clear, evidence-based guidance for various urban environments. This will help urban designers and planners to apply suitable design interventions onto different neighbourhoods to support diverse health outcomes and behaviours (Koohsari, Badland, & Giles-Corti, 2013).

In this project existing researches and case studies will be used to find design interventions which will contribute to the urban health. Certain design interventions will be selected for the design of each neighbourhood. When the impact of the scenarios, of automated mobility, on the residential neighbourhood is clear and the impact is analysed, design interventions can be tested. To improve urban health, the right set of design interventions and scenario determinants need to be combined for each unique location. This research by design method will be used because it will reflect on the design can in a critical way, it explores different perspectives and insights, and investigate various impacts Going back and forward between the design, the design interventions and the scenarios will be an ongoing process of this project.

The second knowledge gap concerns the impact of automated mobility on our cities and societies. Automated mobility is still in an early stage. It is uncertain what will happen on the long term, depending on the pace of technology development and the response of the market. To make sure that the society as a whole gains benefit from automated mobility, social inclusiveness and the way to address vulnerable users need to be taken into account. Addressing the socioeconomic and environmental impact of automated mobility requires new assessment tools and skills (European Commission, 2018).

Case studies will be used for understanding new or existing processes on behaviours. Case studies of the implementation of automated mobility or comparable technologies (now and back in the time) will be used, to understand how the society will deal with them and what effect it will have on the urban environment.

This project will give new insight on how to design for healthier environments. It dives into the impact of automated mobility on residential neighbourhoods and the impact on urban health. Combining these results, this will be translated in a design where automated mobility contributes in improving urban health in residential neighbourhoods.

Concluding, the aim is to improve urban health in residential neighbourhoods, by using automated mobility as catalyst. This is done by developing urban regeneration strategies with a set of design interventions and scenario determinants (theoretically gained) for the two specific existing residential neighbourhoods. Creating and retrofitting urban environments which will improve urban health. The design will be used in an advisory manner. It is used as tool to test the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods, recommendations will set up to guide planners and designers in designing healthy neighbourhoods in a future with automated mobility.

This will contribute to a healthier society and helps policy-makers and urban designers and planners to guide them in designing for urban health.

Research questions

Where the rise of industry and mobility in the nineteenth century, had a negative impact on the health of the society, new technologies might be a catalyst for health. A new chance? The hypothesis of this project is: the implementation of automated mobility can contribute in improving urban health in residential neighbourhoods. The aim of this project is to stimulate physical activity to improve urban health in residential neighbourhoods, by using automated mobility as catalyst.

This has led to the main research question: The following question is leading in this report:

"How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?"

To come to a design a few sub-research questions need to be answered. The sub-research questions are divided into 6 themes. The themes are Situation, Methods, Urban Health, Healthy neighbourhoods, Automated mobility, and Design.

Within the theme Situation the following research question will be addressed: "**What are the mobility and activity patterns right now, in the two selected neighbourhoods?**". The current situation will be mapped to show the networks and systems now.

The theme Methods addresses scenario planning because this will be one of the main methods used to develop a design for an unpredictable future with automated vehicles. The question is: "**How can scenario planning be used during this project to create the most suitable design for the future?**". The chapter addressing this method will elaborate on developing scenario's which can be used in the project and will explain how they can be used.

The theme of Urban Health includes two sub-research questions. The first is: "**What is urban health?**", and the second question within this theme is: "**How can urban health be improved in residential neighbourhoods?**". Here the concept of healthy cities will be further elaborated. This will be done to develop design interventions which will be used to design healthy neighbourhoods. This will mainly be done by literature review and case studies.

The fourth theme, Healthy neighbourhoods, will be focusing on the criteria and main goals for a healthy neighbourhood and how to implement this. The question is: ''**What comprises a healthy neighbourhood?**". Criteria and goals for an healthy neighbourhood will be formed. Those can be used later on to conclude whether or not a residential neighbourhood improves urban health.

The fourth theme addresses the impact of automated mobility on cities and societies. The first question within this theme is: ''**What is the impact of automated mobility on residential neighbourhoods?**", the second is: ''**What is the impact of automated mobility on urban health?**". In these questions, and in all the other questions as well, is the aspect of time very important. The outcomes when the automated mobility is fully adopted will differ from when we are still in the transition period (automated and non-automated vehicles will both be present). The main methods for answering

Research questions	Methods	Outcomes
Main research question		
How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?	- all mentioned below -	urban regeneration strategies, guidelines and design interventions for physical activity stimulating residential neighbourhoods
Sub-research questions		
Situation What are the mobility and activity patterns right now, in the two selected neighbourhoods?	spatial analysis pattern analysis travel behaviour analysis	mobility and activity patterns in the two selected residential neighbouroods in Amsterdam
Methods How can scenario planning be used to during this project to create the most suitable design for the future?	scenario construction scenario planning literature review	scenario(s) which can be used in the project + base scenario - future without AM
Urban health What is urban health? How can urban health be improved in residential neighbourhoods?	literature review case studies	design interventions, guidelines and strategies for physical activity stimulating environments
Healthy neighbourhoods What comprises a healthy neighbourhood?	literature review case studies	determinants of active residential neighbourhood
Automated mobility What is the impact of automated mobility on residential neighbourhoods? What is the impact of automated mobility on urban health?	scenario planning literature review pattern analysis travel behaviour analysis	impacts of AM on residential neighbourhoods and physical activity patterns -> differ according scenario
Design How will automated mobility effect the two neighbourhoods? Which design interventions are needed to improve urban health in these neighbourhoods?	spatial analysis pattern analysis travel behaviour analysis impact analysis	impacts accessment of scenario in the two neighbourhoods design interventions, guidelines and strategies for the two neighbourhoods

Image 23: Research questions - methods - outcomes (own image)

this question are scenario construction and planning, literature review, pattern analysis and travel behaviour analysis.

The last theme will be focusing on two specific residential neighbourhoods. The first question is: "**How will automated mobility effect the two neighbourhoods?**", and the second is: "**Which design interventions are needed to improve urban health in these neighbourhoods?**". Answering this question spatial analysis, pattern analysis and travel behaviour analysis, combined with the outcomes of the other sub-research questions will lead to a set of possible design interventions for the two neighbourhoods.

Image 23 shows an overview of all the questions, methods and outcomes addressed in this project.

Research framework

The scheme of image 24 concludes the Project chapter, see blue boxes. It describes in short the motivation, the problem field, the context, the problem statement, the aim and the research question. The black boxes and conceptual framework describes how the project is going to tackle the research questions. This will be further elaborated in the chapter Methodology. This scheme is used to provide a clear overview of the project at all times, guide the project on how to tackle questions and issues, and it guides in how to come to the desired output.

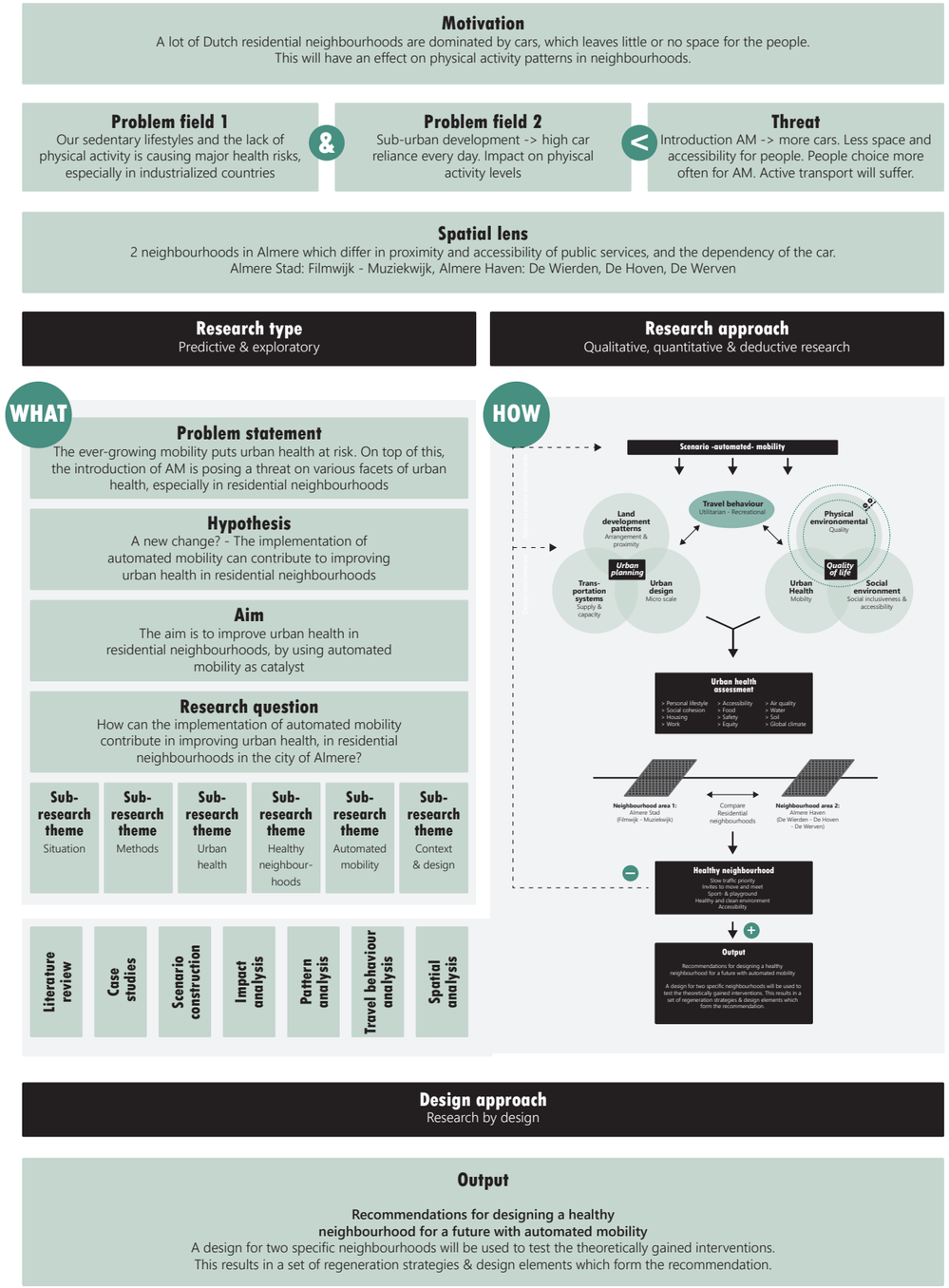


Image 24: Research framework (own image)

Relevance project

Scientific
This project tries to jump into two knowledge gaps to contribute to the scientific body of knowledge. The first gab addresses how to plan/design healthier cities/neighbourhoods. Still, there is not enough knowledge about 'how much' and 'what types' of infrastructure and other urban elements are needed to support urban health. Therefore, this project will search for a set of design interventions, for different neighbourhoods, which will guide urban planners and designers to improve health and behaviour (Koohsari et al., 2013).

The second knowledge gap concerns the impact of automated mobility on our cities and societies. Automated mobility is still in an early stage. It is uncertain what will happen on the long term, depending on the pace of technology development and the response of the market (European Commission, 2018). It is therefore important that research will be done now, to inventory possible impacts and develop strategies and design interventions which can respond to those impacts. In this way cities can adapt (slowly) to the rapid pace of development of technologies.

Social
On a social level the project contributes to healthier and therefore more sustainable cities. By promoting active ways of transport physical exercise can be increased. The chance of getting several physical health related problems like heart disease, diabetes, obesity, and some cancers, will decrease (Guthold, Stevens, Riley, & Bull, 2018). Besides, the travel behaviour of a community influences also the human interaction levels in public places and streets which helps to build communities and enhance the quality of life (Hoehner et al., 2003). On top of this the introduction of automated mobility will come with new innovations in vehicle technology. This will probably lead to cleaner cities with less air and noise pollution, resulting in a better health. Also, automated vehicles will be safer resulting in less traffic accidents.

And, when planning healthy urban areas, the planning practices that are used to improve health and well-being are comparable to the principles used in sustainable development. In this, there is a focus on both human and the environment in the planning practices, rather than focussing only on economics and buildings (Barton & Tsourou, 2000). Sustainability will be both a goal and a result of the healthy city.

Limitations project

Public health researchers share the opinion that changes in the built environment are more effective to increase physical activity than policies influencing health behaviour are (Frank & Engelke, 2001). Although urban planning and design have a big influence on creating healthier cities and neighbourhoods, urban planning on itself is not able to improve all public health issues. Public health issues are namely not influenced by the built environment only, there are also other determinants like social relations, the condition of the house someone's living in, genetic predisposition of diseases, etc. These are all factors which cannot be tackled by actions in the built environment.

Another limitation is that the development of the automated mobility is uncertain. This means that it is not fully predictable what will happen. Strategies and design interventions will be based on scenario's which will be created. The design outcomes are therefore not applicable to all futures. Because, it is possible and highly probable that the automated mobility industry will develop in another way than predicted. This does not mean the research and design is completely useless. Depending on the evolution of the future some aspects of the design can be used in other scenarios. Also, this project provides guidelines in steering AM and cities to later come to the favourable result.

Ethical considerations

The first ethical consideration within this project is that the society as a whole should gain benefit from the introduction of automated mobility. How to address vulnerable users and social inclusiveness needs to be taken into account (European Commission, 2018). Vulnerable people cannot be disadvantaged in any way. In the design for a future with automated mobility there is an opportunity to include vulnerable groups, because now they can drive in a car without a drivers license needed. A system could be created that this group of people have advantages compared to 'normal' people. The autonomous car can pick them up everywhere and anywhere, where 'normal' people have to go to a specific pick-up point.

Other ethical considerations related to for example the responsibility of driving must also be addressed within the field of mobility. Who is liable when an automated vehicle is involved in an accident?, Are the vehicles safe? and Do they give us our personal freedom of choice? (European Commission, 2018), are all questions which have to be addressed. Also ethical considerations in programming the vehicles is important in the process of the development of automated mobility. 'How to program split-second calculations into an automated vehicle that could harm one human over another?' (Chipman, 2015), is an important question to answer. All situations should be carefully programmed. This might not be questions for urban planners/designers, however it is useful to know about the discussion and get involved in it.



Image 25: Future self-driving cars now (Korbelová, 2017)

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METHODOLOGY

Conceptual framework

In image 26 is the conceptual framework for this project shown. The conceptual framework is created to provide a comprehensive understanding of phenomena, by linking concepts (Jabareen, 2009). It represents the way of thinking and shows the complexity of a problem (Bordage, 2009). This paragraph will elaborate on the concepts and their interrelations, methods are mentioned but further elaborated in the paragraph Methods.

In the conceptual framework the impact of -automated- mobility on urban health in two specific residential neighbourhoods is elaborated. This is derived from the main research question: "**How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?**"

The impact of -automated- mobility on urban health in the residential neighbourhoods is mainly determined by the fields of urban planning and quality of life, and the manifestation of the determinants within the fields. On top of that, variable scenario's input will provide various outcomes, in favour of or at the expense of urban health.

Scenario

The conceptual framework starts with the scenario at the top. Scenario planning is used to understand complex and uncertain futures (Peterson et al., 2003). The scenario includes a vision for a future with automated mobility. The scenario will be constructed by the creation of a framework with different constructing elements which will determine the future. In this conceptual framework is shown that the scenario will have an impact on the two main determinants, urban planning and quality of life. Each scenario will result in a different manifestation of the determinants and therefore lead to other impacts on the urban health in the neighbourhoods. The scenarios of automated mobility can influence the main determinants in a positive or in a negative way in terms of improving urban health.

Urban Planning

To understand the built environment and the possibilities for improving urban health, urban planning is broken down into three components: urban design, land development patterns and transportation systems (Frank & Engelke, 2001).

Urban design on micro scale has a big influence on the pedestrian and cyclist. When a street maintains the visual and sensory attention of the pedestrian the street will be more highly valued. Streets will be perceived safer when there are wide sidewalks and bike lanes. Also, the speed of the traffic along the street will influence the safety perception. The placement of building blocks, parking lots and other objects, will have an impact on the desirability of active travel (Frank & Engelke, 2001).

Arrangement and proximity of activities are defined by land development patterns. Higher densities result in shorter trip lengths, reduced vehicle ownership and more options for different modes. The land use mix and proximity of activities to one another, relates to a reduced trip length and vehicle ownership as well, and also results in an increased public transport usage for commuting, and increased options for modes (Frank & Engelke, 2001). Sub-urban development will result in a higher car dependency, longer trip lengths, and less options for different trans-

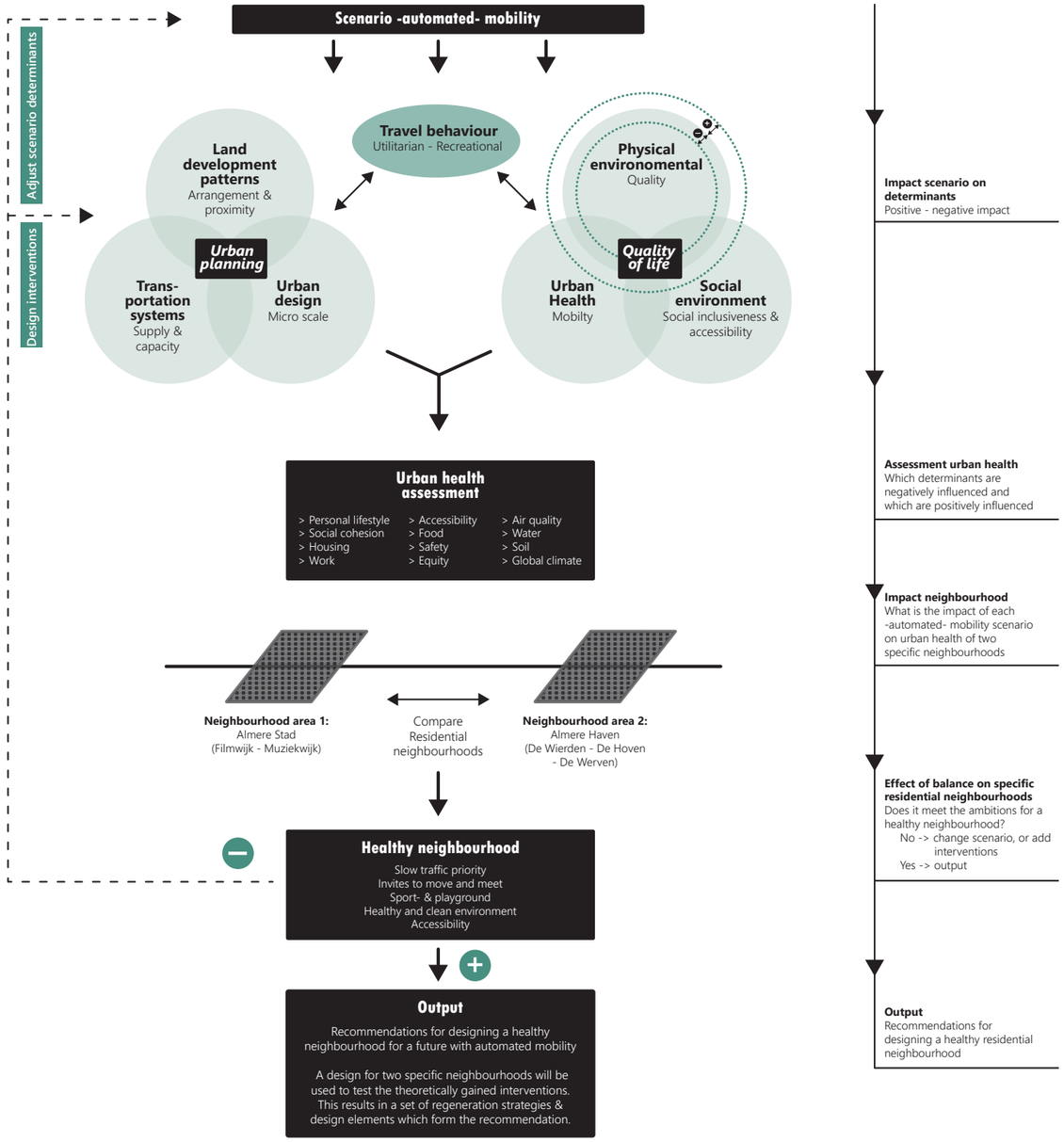


Image 26: Conceptual framework (own image)

portation modes. It can lead to a horizontal metropolis.

Providing connections between activities, transportation systems determine physical pathways. The supply and/or capacity of these pathways has its impact on the choice of modes for travelling. The design of the street will influence the quality of travel and the directness of the travel. On the urban scale the ability to walk or bike between activities is determined (Frank & Engelke, 2001).

Quality of life

A good quality of life includes ''good health, feeling good, having social relationships, being active, helping other people and living in a nice home in a good neighbourhood" (Campen, 2011, p. 43). Therefore, the topic of quality of life is here split into three determinants: the quality of physical environment, social environment and urban health.

Events, forces and phenomena which are related to materials and other spatial domains and take place outside the individual, are defined as physical environment (Wahl, Mollenkopf, Oswald, & Claus, 2007). A qualitatively good physical environment can stimulate people to walk or cycle more, and improve their well-being.

When someone has only a few social resources, people tend to be marginalized, stigmatized, and have a lower quality of life. People who are interconnected, have more social resources and are engaged in interactive activities tend to be more positively adjusted. Globally they have a better mental and physical health (Antonucci & Ajrouch, 2007).

Although living in cities brings individuals and families great opportunities, also some health risks emerge due to urbanisation. These risks vary per city and local context. Common urban health risks and social challenges are infectious diseases exacerbated by poor living conditions. Besides, non-communicable diseases like heart disease, cancers, obesity and diabetes. These can be caused by unhealthy diets and physical inactivity. Besides, accidents, injuries, violence and crime influence the urban health (World Health Organisation, 2010, p. 9). Promoting activity in stead of mobility will improve urban health which will lead to a lower risk of getting non-communicable diseases.

Travel behaviour

Travel behaviour combines the interests of transportation planning and urban design. Its about the understanding the impact of a physical environment, the built environment, on human behaviour. Physical activity and human interaction within a community are influenced by the design of the public space and can help to build communities and enhance the quality of life (Hoehner et al., 2003). The demand for walking and cycling is in relation to urban planning often a utilitarian model for active living. On the other hand, public health related with emphasizing leisure-time, has a more recreational model for active living (Hoehner et al., 2003). Travel behaviour analysis can include both data & pattern analysis, and observation studies.

Impact

Following the framework, the determinants of urban planning and quality of life are influenced by each scenario of -automated- mobility. The manifestation of the determinants in the city and the society, without doing anything, will influence the urban health of the community.

The urban health of the community of each individual neighbourhood can be assessed by the urban health determinants. With this, information can be gained on how urban health is expressed in each neighbourhood.

To check whether or not the scenario will have a positive impact on the urban health of a neighbourhood, healthy neighbourhood ambitions are set up. In this way can be assessed if the scenario on its own already results in a healthy neighbourhood, or adjustments need to be made to create a healthy neighbourhood.

Concluding, does the scenario derives a healthy neighbourhood, and meet the health neighbourhood ambitions?:

No -> then design interventions (gained from the theory) are needed to 'tune' the determinants. Also, the scenario can be adjusted. However, the scenario is constructed according to certain predictions and argumentations. It is not always correct, fair or just to change this to come to a favourable result. But, some policies which can deployed now can steer the manifestation of automated mobility in the future.

Yes -> then can be continued with the output.

Output

For each neighbourhood recommendations will be provided, which contain urban regeneration strategies and a set of design elements. Creating and retrofitting urban environments which will improve urban health.

Besides, for new urban development some guidelines will be provided which can be applied to new healthy neighbourhoods with automated mobility.

Research methodology

This paragraph will focus on the research methodology which will be applied in this project. This concerns the research type, the research approach, the research philosophy and the research strategy. These are as well incorporated in the research framework (see image 27, black boxes).

Research type

Since this project concerns the topic automated mobility and the impact of it on the urban health, the research type is a predictive one. For the project it has to be predicted when and where future development will take place. Questions like: 'when will the automated vehicles be fully integrated in our society?', 'what will happen during the transition time?', 'will there new modes of transport?', 'how is our travel behaviour and culture affected?', must be answered to anticipate to what is coming. Future possibilities have to be analysed and available evidence on causes and effects needs to be considered in this predictive research (Calabrese, 2018). An imported method within this research type is scenario construction. Scenario planning is used to understand complex and uncertain futures (Peterson et al., 2003). For the scenario a framework will be developed in which different factors, influencing the future, can be altered. The factors include for example the attitude towards new technology (decline - embrace) and whether the automated vehicles are allowed everywhere (limited access - unlimited access).

Besides the project being a predictive type of research, the project is also exploratory. Concentrating on future developments in automated mobility, and especially focusing on the impact on urban health on the neighbourhood scale, there are only a few studies carried out. At the heart of this type of study lies looking for patterns and hypothesises.

Where the rise of industry and mobility in the nineteenth century, had a negative impact on the health of society, new technologies might be a catalyst for health. A new chance? The hypothesis is: the implementation of automated mobility can contribute to improving urban health in residential neighbourhoods. This has also led to the main research question. To understand when and how automated mobility can stimulate health, this project is looking more into mobility patterns and activity patterns, and the balance between them. By the end of the project we will know whether automated mobility can be a catalyst for health in residential neighbourhoods, and how. Methods used in this type of research combine case studies and observational studies (Calabrese, 2018), in this case pattern analysis and travel behaviour analysis. These methods will be elaborated in the methods paragraph.

This project combines the predictive research with the exploratory research. The predictive research looks more into the future impact of automated mobility and the exploratory research focuses on the possibilities of the future, in a field which is not existing (yet).

Research approach

In this applied research the project answers specific questions aiming to solve practical problems in particular situations (Couri, n.d.). This comes forward in the output of the project. It creates new products, in this case urban regeneration strategies, guidelines and design interventions which will improve urban health, which can be applied in residential neighbourhoods. This approach is used, on the one hand, to create an urban design for two specific neighbourhoods. On the other hand, it might provide guidelines for other, comparable existing or new, neighbourhoods which have to tackle the same problems in the future.

This research project has a deductive nature. A deductive research starts with a general theory or idea and moves towards a theory applied to a specific situation (Hyde, 2000). In the case of this project, already existing and general problem fields are addressed and explored. This is overlaid with the impact of the automated mobility on these fields. From this, the impact of automated mobility on sub-urban regions and health is further elaborated. Leading to certain, general conclusions. Later on, this is projected on two specific locations to see what the impact here could be. Design interventions, derived from explorations of the field, can be applied to improve urban health.

In the project both qualitative and quantitative approaches will be used. The qualitative approach focuses on observations which express reality. Concentrating on more subjective and intangible topics this approach aims to describe people in their natural situations. The quantitative approach, on the contrary, emphasises on collecting data and theories to support evidence. Numbers represents opinions or concepts (Amaratunga, Baldry, Sarshar, & Newton, 2002). This synthesis between quantitative and qualitative is often mentioned as mixed method. Greene (2006) states that investigating the social world and human phenomena to understand it better, in more than one way of knowing and using more than one technique, is what concerns a mixed method approach (Johnson, Onwuegbuzie, & Turner, 2007).

Rossman and Wilson (1991) state that it is important to link the qualitative and quantitative approaches because it elaborates analysis leading to richer outcomes. On top of that, it introduces new ways of thinking which produces fresh insights (Amaratunga et al., 2002). Quantitative data helps a qualitative design study by finding relevant samples. Qualitative data in a quantitative design study can help with conceptual development and tools (Amaratunga et al., 2002).

The quantitative site of this project is more related with supply and capacity of for example pathways or the arrangement and proximity of attractions. On the contrary, the qualitative site of the project is more focused on the (partly) intangible topics, like how people move and why and good health and well-being is. This part of the project focusses more on travel behaviour, quality of space and social environments. It could be assumed, looking at the conceptual framework, that the left determinants (under urban planning) form the more quantitative side of the project and that the right determinants (under quality of life) form the more qualitative side. By means of observations studies, like travel behaviour analysis, it tries to understand communities and environments.

Research philosophies

Since both quantitative and qualitative approaches are adopted in the project, both

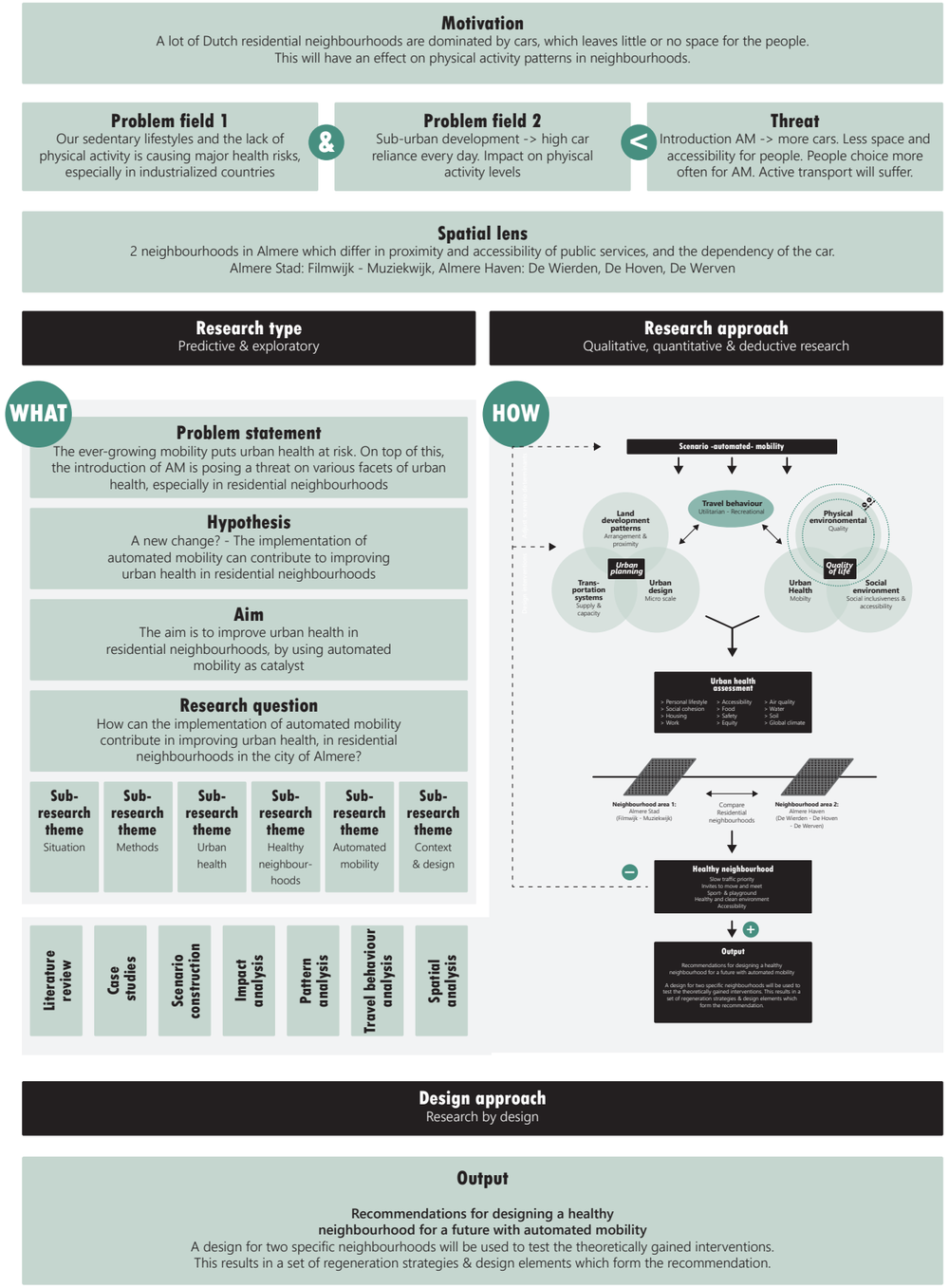


Image 27: Research framework (own image)

positivistic and phenomenological research philosophies are addressed in the project as well. Positivism uses quantitative methods to test hypothesises and generalisations to determine rules and laws. Positivistic studies reduce their outcomes to the simplest possible elements (Amaratunga et al., 2002; Atkinson, 2017). In this project a positivistic approach is used when different scenarios are tested and assessed within the different neighbourhoods to rigidly structure the impacts on urban health. Generalisation of the possible impacts are listed and coupled to design interventions which help to improve negative impacts. This will be done because then it is for more then one neighbourhood usable and applicable.

The phenomenological philosophy echoes in this project by using qualitative approaches. This translates itself in the understanding of human experiences, interactions and phenomena in their contexts, rather than searching for causal explanations or fundamental laws (Amaratunga et al., 2002). In the project the phenomenological approach is used to engage with people and communities (Atkinson, 2017). It addresses intangible and humanistic topics concerning our attitude towards new developments which will affect our travel behaviour.

Research strategy

The research strategy for this project is research by design. Producing knowledge through the act of designing, aiming to generate insights, knowledge, perspectives, practices and products, is what is describes as researching by (or through) design. It describes the numerous ways of interconnection between research and design. This type of investigation not only explores different ways of developing a project but also explores different materials of visualisation that makes the project discussable with others (Hauberg, 2011; Roggema, 2016). For the project the research by design strategy seems appropriate because designing can be used in a critical way, by exploring different perspectives and insights, to investigate various impacts of automated mobility on two specific residential neighbourhoods. Different scenarios and design interventions can be tested in the locations. If this does not result in something desirable another concept or idea can be further investigated and elaborated. Later this can be tested again. This can be done until the desired result is obtained.

Methods

Knowing the types, approaches, philosophies and strategy of research for this project, now in this chapter the methods on how to tackle the research questions are addressed. In the image 28 are the research questions and their methods described, which can be used in investigating the questions.

Theoretical approach

Literature review

By means of literature review different ideas and perspectives of different scholars and practitioners are elaborated. Not only focuses the literature review on the ideas and perspectives of the scholars, also, an in-depth study into their ways of tackling questions will be done to learn from their experiences and approaches. The literature review will be used to collect analysis, knowledge, perceptions, data and approaches (Amaratunga et al., 2002). In this project this will be mainly done within the sub-research themes of Urban Health, Healthy Neighbourhood, and Methods. Within the Urban Health theme literature review will be used to understand what urban health is and how to design for a healthy neighbourhood. In the Healthy Neighbourhood theme literature review will be used to determine which elements have which impact on travel behaviour and what the building blocks for a healthy neighbourhood are, this will be also done by reviewing case studies. On the Methods theme literature review will be on the one hand used to understand what scenarios are and how they could be used, on the other hand, will it be used to dive into the knowledge and predictions of a future with automated mobility.

Case studies

As Yin (2009) describes in his book Case Study research: Design and Methods, ''a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2009, p. 13). Case studies can be used for understanding new or existing processes on behaviours. It includes numerous research methods and a range of different data. Case studies can be used during this project as comparative research. Case studies can be convenient when an understanding of people's behaviour and experiences under certain circumstances is needed. Understanding processes and how they take place in a specific context is the key aspect of case studies (Amaratunga et al., 2002). During this project case studies will be used to learn from physical activity stimulating environments that already exist, addressing the knowledge gap between urban planning and urban health. Also, case studies of the implementation of automated mobility will be used, however there are not a lot of these available (yet). Comparable developments in history can be used as case study to mimic future situations.

Spatial approach

Scenario construction

To understand complex and uncertain futures, scenario planning is used as a systematic method. Scenario planning takes into account a range of possible futures which includes its uncertainties as a whole (Peterson et al., 2003). Scenario planning simplifies the wide range of data into a limited number of possibilities. Each scenario tells how elements

Research questions	Methods	Outcomes
Main research question		
How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?	- all mentioned below -	urban regeneration strategies, guidelines and design interventions for physical activity stimulating residential neighbourhoods
Sub-research questions		
Situation What are the mobility and activity patterns right now, in the two selected neighbourhoods?	spatial analysis pattern analysis travel behaviour analysis	mobility and activity patterns in the two selected residential neighbouroods in Amsterdam
Methods How can scenario planning be used to during this project to create the most suitable design for the future?	scenario construction scenario planning literature review	scenario(s) which can be used in the project + base scenario - future without AM
Urban health What is urban health? How can urban health be improved in residential neighbourhoods?	literature review case studies	design interventions, guidelines and strategies for physical activity stimulating environments
Healthy neighbourhoods What comprises a healthy neighbourhood?	literature review case studies	determinants of active residential neighbourhood
Automated mobility What is the impact of automated mobility on residential neighbourhoods? What is the impact of automated mobility on urban health?	scenario planning literature review pattern analysis travel behaviour analysis	impacts of AM on residential neighbourhoods and physical activity patterns -> differ according scenario
Design How will automated mobility effect the two neighbourhoods? Which design interventions are needed to improve urban health in these neighbourhoods?	spatial analysis pattern analysis travel behaviour analysis impact analysis	impacts accessment of scenario in the two neighbourhoods design interventions, guidelines and strategies for the two neighbourhoods

Image 28: Research questions - methods - outcomes (own image)

interact with each other in certain situations. Scenario planning aims to find balance between under- and overprediction of the future (Schoemaker, 1995). In this project a few scenarios will be constructed which inform on the development of automated mobility. Within different themes, for example technology, culture & attitude, and accessibility determinants for the scenario will be set. Using predictions, knowledge and assumptions the scenarios, which will be used during the whole project, will be constructed. The scenarios form the heart of the project.

Spatial analysis
Spatial analysis consists of a number of methods. At the heart of it lies mapping existing, predicted and desirable systems. ''Mappings are neither depictions nor representations but mental constructs, ideas that enable and effect change" (Corner, 2002, p. 250). Mapping sets the stage for future work by describing and visualizing hidden facts. Mapping is a part of the development of the project (Corner, 2002). In this project mapping will be used to look for opportunities in existing systems when overlapping with different scenarios. First, in the theme of Situation, the existing networks, systems and patterns of mobility and activity will be mapped. It will be predicted how these networks, systems and patterns will develop without automated mobility, but with the current trends. Then, the scenarios for automated mobility will be overlaid to evaluate what the impact of automated mobility will be on the networks, systems and patterns.

Pattern analysis – pattern matching
When similar results happen for a predictable reason we can speak of patterns. Spatial pattern analysis focuses on describing the observed patterns of data in space. Also, it tests whether the observed pattern differs from the predicted/expected patterns. Pattern matching compares empirically-based patterns with predicted patterns (Amaratunga et al., 2002; Anderson & Rosenberg, 2016). Understanding the patterns across multiple life domains, within different contexts, helps to identify strategies to come up with design interventions and policies for different groups in different contexts (Rovniak et al., 2010). In this project the pattern analysis mainly focuses on understanding (physical) activity patterns and (automated) mobility patterns. This method will be used because in this way situations with or without automated mobility can be compared properly. This is needed to define the impact on the two specific residential neighbourhoods.

Travel behaviour analysis
Travel behaviour analysis can include both data analysis and observation studies. Data analysis consists of a few flows of activity, namely data reduction, data display, and conclusions and verifications. Observation studies concerns the experience of the people and the way they think, feel and act. Besides observations, there are also other methods used to map human activity, like documentation, discussion, interviews, etc. To emphasise the importance of human meanings this project uses travel behaviour analysis (Amaratunga et al., 2002). Travel behaviour analysis will be used to understand how people move and why. To get a better understanding of the choice for active or non-active modes of transports. By understanding this way we use our transport modes now we can predict how they will be used in the future.

Impact analysis
In this project an impact analysis will be used to assess the pros and cons of different scenarios of automated mobility. In this way it tries to identify the potential consequences of this change in societies and cities. Using a set of indicators for, among other things, health the scenarios and their impact on the neighbourhoods will be compared.

Roadmap project

This paragraph will explain how and which methods will be used when during the project. The conceptual framework, research questions, selected research approaches and methods have led to this roadmap for tackling the project Healthy Neighbourhoods. This roadmap will be used for the base structure of the report, the chapters are derived from this sequence of steps.

The first step, tackling the first sub-research theme Situation, is addressing the situation right now in the two selected areas in Almere (in this case is the area in Almere Haven shown as a concept-example). The existing mobility patterns and activity patterns will be mapped. This will be done using spatial analysis to understand what is present and where. Also, pattern analysis will be used, when similar results happen for a predictable reason we can speak of patterns. Spatial pattern analysis focuses on describing the observed patterns of data in space. Also, it tests whether the observed pattern differs from the predicted/expected patterns (Amaratunga et al., 2002; Anderson & Rosenberg, 2016). Travel behaviour analysis will be used to understand how people move and why. In this way a better understanding of the choice for active or non-active modes of transports can be formed.

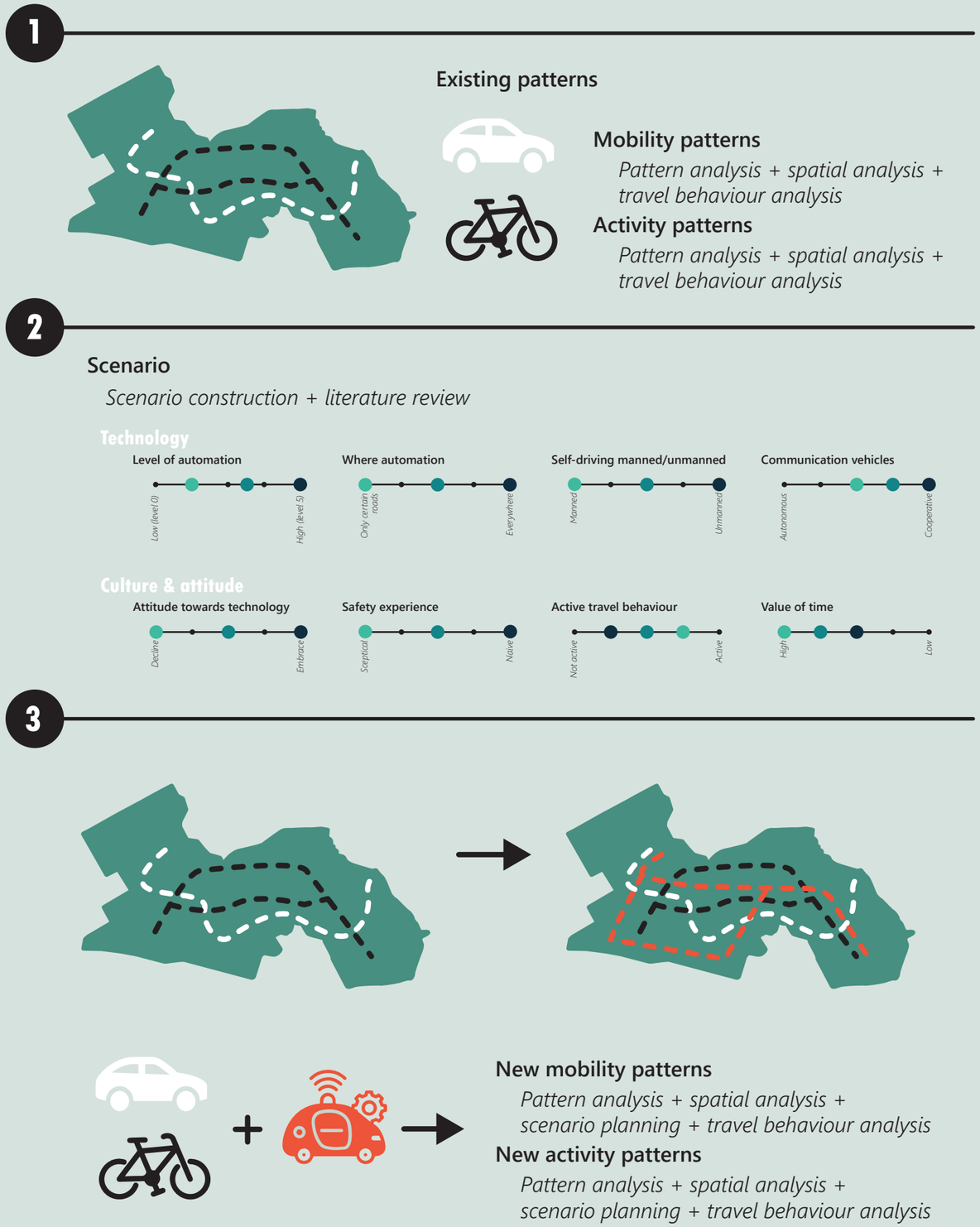
Within the second step the scenario, which will be used during the whole project, will be constructed. Within different themes, for example technology, culture & attitude, and accessibility determinants for the scenario will be set. By means of using a conservative development scenario, a realistic development scenario and a progressive development scenario, the scenario for this project will be defined.

Step 3 will focus on the spatial impact of automated mobility on the two residential neighbourhoods. Like in the first step, the new mobility and activity patterns will be mapped. This will be done for the different scenarios which are created in step 2 (sub-research theme Methods).

In the next step will be assessed what the urban health consequences will be of spatial impact of the scenarios with automated mobility. By using some health determinants an assessment will be made to see which determinants are positively or negatively influenced by the scenarios.

According to the results in step 4, in step 5 interventions will be added to find out how to achieve a healthy neighbourhood. The interventions will form a theoretical framework in designing for a healthy neighbourhood. First there are 'analogue' design interventions which will be deployed in the physical urban environment. On the other hand there are technological interventions, which will be deployed by the scenario determinants which determine the manifestation of autonomous vehicles in the city. The scenario determinants will inform the scenarios and affect urban health and improve it when used in the right way. Finding the two types of interventions, which are also sub-research themes, will be mainly explored by using literature review and case studies.

In step 6 will be checked if the design for the neighbourhood meet the healthy →



4

Impact assessment

Impact analysis different scenario's

Urban health determinants

> Personal lifestyle	> Accessibility	> Air quality
> Social cohesion	> Food	> Water
> Housing	> Safety	> Soil
> Work	> Equity	> Global climate

	Scenario b	1	2	3
Indicators	+	-	O	+
	-	+	+	+
	-	+	-	-
	-	-	-	O
	O	-	O	+
	+	+	-	+
	O	-	-	-

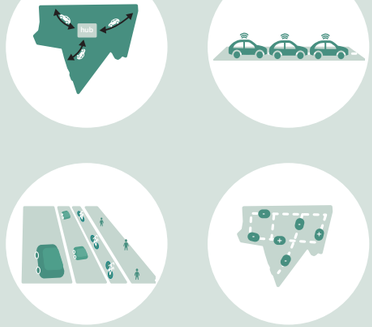
5

Deploying interventions

Design interventions



Scenario determinants



6

Healthy neighbourhood building blocks

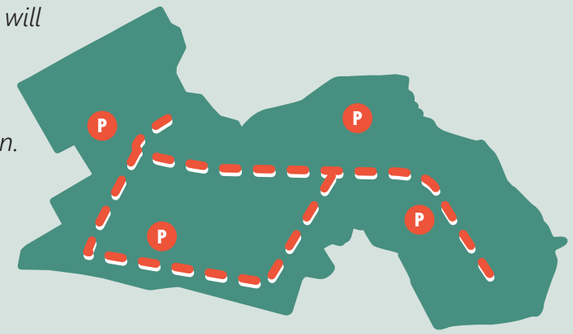
Check if the design meet the building blocks



7

Design testing

A design for two specific neighbourhoods will be used to test the theoretically gained interventions. This results in a set of regeneration strategies & design elements which form the recommendation.



8

Output recommendations

Design elements uravelled from the design form the recommendations in designing healthy neighbourhoods





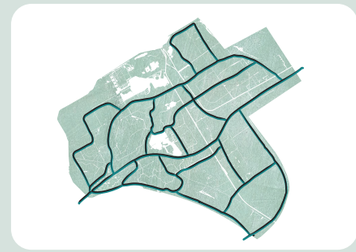


Image 29: Approach project (own image)

→ neighbourhood ambitions. The healthy neighbourhood ambitions guide urban planner/designers in considering health in a design or in the redesign of neighbourhoods, parks, streets and squares.

According the ambitions and with help of the interventions an integral design will be made where all elements regarding typologies, measurements, ecology, economy, etc. are put together. This resulted in a design on the city scale, the district scale, and the neighbourhood scale.

Yet, in this project the design plays an advisory role. It is used as tool to test all the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods recommendations will be made to guide planners and designers in designing healthy neighbourhoods in a future with automated mobility. A number of design elements will be set up to meet the healthy neighbourhood ambitions.

Intended outcomes

The intended outcomes are recommendations to guide urban planners/designers in designing healthy neighbourhoods in a future with automated mobility. In this project the design plays an advisory role. It is used as tool to test all the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods recommendations will be formed. A number of design elements will be set up to meet the healthy neighbourhood ambitions. The designs will be made for two areas in Almere, namely in Almere Haven the neighbourhoods De Werven, De Hoven and De Wierden. And in Almere Stad the neighbourhoods Filmwijk and Danswijk. For a more detailed design of the public space and streets, will be zoomed in to specific locations in which different services will be present.

The design will be made for the progressive scenario, when the automated vehicles are fully embraced and implemented. With information gained from this can be said which design interventions and scenario determinants should be deployed in an earlier stage (an other scenario).

Besides designing for the situation also some guidelines will be created for new neighbourhoods. This will also consist of a set of design elements and recommendations, which can be applied to new healthy neighbourhoods in a future with automated mobility.

The aim is to improve urban health in residential neighbourhoods, by using automated mobility as catalyst. This is done by developing urban regeneration strategies with a set of design interventions and scenario determinants for the two specific existing residential neighbourhoods. Creating and retrofitting urban environments which will improve urban health. The design will be used in an advisory manner. It is used as tool to test the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods, recommendations will be set up to guide planners and designers in designing healthy neighbourhoods in a future with automated mobility.

With the information from these tests in the design of the progressive scenario can be said which interventions should be made in earlier scenarios, and also what is needed for new neighbourhoods.

This will contribute to a healthier society and helps policy-makers and urban designers and planners to guide them in designing for urban health.



Image 30: Future self-driving car 1950s (Johnson, 2017)



Image 31: Future self-driving cars now (Korbelova, 2017)

Conclusion

In the chapter Project and Methodology the foundation of the project Healthy Neighbourhoods is described. The chapter Project elaborated on the content of the project. The main motivation of this project is the car dominance and dependency in a lot of Dutch residential neighbourhoods, putting urban health at risk. Besides, the chapter elaborated on the threat of the introduction of automated mobility on urban health. Therefore, in this project two knowledge gaps will be addressed. First, the knowledge gap between urban planning and urban health. Many planners still do not fully know how health is affected by environmental factors (Srinivasan et al., 2003). The second knowledge gap is the lack of knowledge of the impact of automated mobility on cities and societies, and especially on health.

This project discusses the following problem fields, which are all connected to each other. First, the growing mobility is putting urban health at risk by e.g. pollution and accidents But not only growing mobility, also the urban development of our cities will have an influence on urban health. Suburban development causes a population level reliance on car use every day. This imposed reliance causes low physical activity levels in a lot of residential neighbourhoods among many industrialized countries (Badland & Schofield, 2005).

Our sedentary lifestyles and the lack of physical activity is causing major health risks, especially in industrialized countries. Annually, approximately 1.9 million deaths are caused by physical inactivity (Badland & Schofield, 2005). Easy executable and moderate forms of physical activity, like walking and bicycling, can already contribute to a healthier lifestyle. It reduces the chances of getting non-communicable diseases like obesity, heart diseases, diabetes (type 1), some cancers, anxiety, depression, and so on (Frank & Engelke, 2001).

These mobility trends on itself causes already a lot of problems, however with the introduction of the automated mobility there is a threat that this problem gets even bigger. Due to the attractiveness of the new motorized transport modes in terms of costs and travel time (value of time), the share of cycling and walking can decrease (Arcadis, 2018). The general idea is that automated vehicles lead to higher pressure on the road network. The increase in vehicle kilometres can be explained by a changing modality choice among users. Automated vehicles make mobility more accessible to a wider audience as a result of expected lower costs, with longer distances being covered. Leading to more vehicles driving around (Arcadis, 2018). This, again, can result in less availability of quality public open space, which has an effect on physical activity patterns in neighbourhoods (Koohsari et al., 2015).

The scope of this project is narrowed down to residential neighbourhoods, since the largest part of our society lives in residential neighbourhood and the car dependency is here the highest. Two areas in Almere are selected, because inhabitants in Almere commute a lot. The first area is Almere Haven and consist of the neighbourhoods De Wierden, De Hoven and De Werven. The second area is in Almere Stad and consist of the neighbourhoods Filmwijk and Muziekwijk.

Summing up, the ever-growing mobility puts urban health at risk. On top of this, the introduction of automated mobility is posing a threat on various facets of urban health (personal lifestyles, accessibility, etc.), especially in residential neighbourhoods (because of the high car dependency.

The challenge is to improve urban health in residential neighbourhood while mobility is growing and automated mobility is introduced and poses a threat on urban health.

Where the rise of industry and mobility in the nineteenth century, had a negative impact on the health of society, new technologies might be a catalyst for health. A new chance? The hypothesis of this project is: the implementation of automated mobility can contribute in improving urban health in residential neighbourhoods. The aim of this project is to improve urban health in residential neighbourhoods, by using automated mobility as catalyst.

This has led to the main research question: "**How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?**". To understand when and how automated mobility can stimulate health, this project is looking into the impact of the -automated- mobility patterns on urban health.

To answer this question and to come to a design for the two neighbourhoods, a few sub-research questions need to be answered. The sub-research questions are divided into 6 themes. The themes are Situation, Methods, Urban Health, Healthy neighbourhoods, Automated mobility, and Design. All sub-research questions are linked to certain methods. The main method of this project is scenario construction and planning. In this project a few scenarios will be constructed which will serve as guiding framework for the rest of the project. Within different themes, for example technology, culture & attitude, and accessibility determinants for the scenario will be set. Using predictions, knowledge and assumptions the scenario(s) will be constructed. The constructed scenario forms the heart of the project, to deal with an unpredictable future.

The scenario construction forms, as well, the starting point for the conceptual framework. Each scenario will influence the main determinants. The impact on these determinants, urban planning and quality of life, will be visualised. The determinant of urban planning is dealing with supply and capacity of pathways or the arrangement and proximity of attractions, which is the more quantitative site of the project. On the contrary, the qualitative site of the project is more focused on the (partly) intangible topics, like how people move and why. This part of the project focusses more on travel behaviour, quality of space and social environments, which can be found back under the determinant quality of life. The manifestation of the determinants this will have its influence on the expression of urban health on two residential neighbourhoods. This impact will be assessed to figure out of this scenario will inform a healthy neighbourhood. If this is not the case design interventions and scenario determinant are used to adjust the manifestation of the determinants.

The research strategy for this project is research by design. Producing knowledge through the act of designing, aiming to generate insights, knowledge, perspectives, practices and products, is what is describes as researching by (or through) design (Hauberg, 2011; Roggema, 2016). For the project the research by design strategy seems appropriate because designing can be used in a critical way, by exploring different perspectives and insights, to investigate various impacts of automated mobility on two specific residential neighbourhoods.

When the impact of the scenarios, of automated mobility, on the residential neighbourhood is clear and the impact is analysed, design interventions can be tested. When the scenario in combination with a certain set of design interventions and scenario determinants result in the right balance, an healthy neighbourhood can be created. From this design recommendations can be derived, using the design as advisory tool.

The aim is to improve urban health in residential neighbourhoods, by using automated mobility as catalyst. This is done by developing urban regeneration strategies with a set of design interventions and scenario determinants for the two specific existing residential neighbourhoods. Creating and retrofitting urban environments which will improve urban health. The design will be used in an advisory manner. It is used as tool to test the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods, recommendations will set up to guide planners and designers in designing healthy neighbourhoods in a future with automated mobility.

With the information from these tests in the design of the progressive scenario can be said which interventions should be made in earlier scenarios, and also what is needed for new neighbourhoods.



Image 32: Suburbia America (sallyedelstein, 2013)

SUBURBIA ALMERE

Suburban urbanity

In the Netherlands, between 1945 and 1965 the size of the population increased by three million. Public housing and urban planning served the economic, social and spatial modernization in the 1950s and 1960s. New residential areas became the places where the modernization of society took shape. The city expansions played an important role in modern architecture and urban development. People were convinced that only high-rise buildings could shape a new society. These high-rise buildings were easier to build and reached higher densities. The collectivity of the public space between more concentrated building blocks, were key elements of the urban development. Expressing that the individual resident was part of a larger whole. The neighbourhood life played a central role, it was hardly about living in the city. An anti-urban attitude dominated in spatial planning and public housing. Besides anti-urban, post-war spatial policy also showed anti-suburban features.

In the early 1970s a transition took place from high-rise to low-rise in Dutch growth centres (Dutch = groeikernen). New town Almere was primarily a reaction to the Bijlmer as a large-scale urban expansion with high-rise buildings. In the field of public housing, the new city with single-family dwellings represented the emancipation of the working class by the welfare state (Nio, 2016).

Societal changes

In the Netherlands, the demolition of the pillarized society (Dutch = ontzuiling) and rapid social modernization took place in the second half of the sixties. These developments influenced both the collective modern experience and the individual experience during this time. In the 1960s the prosperity increased resulted in higher incomes, more spare time, social and cultural changes, the rise of a mass culture and a growing middle class. There was a growing demand for single-family houses. The planning and design of new towns were inextricably linked with these changes in societal and economic developments (Nio, 2016).

The new towns had to meet urbanity and respond to new social-spatial practices and living. Single-family house in a quiet environment, within the reach of urban environments, was key in the development of new towns. This ambivalent quality has been characterized as 'suburban city' or 'suburban urbanity' (Nio, 2016).

The planning and construction of these new towns took place in a period in which modernity acquired a more intense and massive character, through the acceleration of social modernization. This had a great influence on the daily life. This happened on a social and cultural level (new household forms, a growing middle class, higher education, other leisure activities, pop culture), on a political level (democratization, emancipation), on an economical level (office employment, more prosperity and consumption, home ownership), on a technological level (new transport systems, increased possession of cars, televisions and household appliances) and on a spatial level (mobility, emergence of shopping centres, suburbanisation, long-distant holidays) (Nio, 2016).

To illustrate, in contrast to today, first traffic jams were a real phenomenon. Many people were pleased with the first traffic jams in the Netherlands, because the traffic jam was a sign that things went well with the country. Especially the people who were not part of the traffic jam themselves, were fascinated by the phenomenon (see image 33) (Is geschiedenis, n.d.).

The planning of the new towns align with the ideas of the Enlightenment, in which an increasing rationality of life and society leads to progress. Governments shaped new societies based on increasing prosperity, mobility, home ownership and consumerism. Car, television, domestic appliances and new forms of leisure activities gave a boost to the social, cultural and physical mobility of the population. The connection between lifestyle and physical environment softened. On the one hand privatization of daily life occurred, on the other hand there was an increase in scale. In the plans for the new towns, an answer to this modernization had to be formulated. The new towns had to take account of changes in consumption patterns, car mobility, mass culture, single-family homes and post-industrial employment (Nio, 2016).

Just as urban openness is characteristic of the urban character of the old city, the new suburban urbanity is shaped by the collective organisation of the private life (Berg, Franke, & Reijndorp, 2007).

New towns

A new town has three main characteristics. First, there is a political decision to create a settlement. Secondly, it has a planned structure: a master plan has been created. And thirdly, these cities have been realized and expanded in a relatively short time. Besides, most form, as modern projects of the post-war welfare states, an answer to the increasingly growing cities. This was done by the realisation of single-family houses. These cities became laboratories for experiments with different forms of low-rise buildings.

The new cities differ from the unscheduled suburbanisation around European cities in the Interbellum and the 'suburban sprawl' that became visible in the United States in the fifties because of clear planning goals. They had to become 'real' cities in comparison with the mono-functional early post-war expansion neighbourhoods. However, the concept



Image 33: First traffic jam in the Netherlands (autoblog.nl, 2010)

of urbanity was redefined by spatial and social changes (Nio, 2016).

In the optimistic sixties, the new towns had to express 'the age of affluence, mobility and increased leisure', the freedom of choice and emancipation, and the new comfortable life. A life where the residents could make use of the best of both worlds: both urban qualities and modern achievements that facilitate suburban living, such as a private car and technical equipment for homes. The new towns had a paradoxical objective: they had to become suburban and urban (Nio, 2016).

Almere

At the end of the fifties there was the fear in the Netherlands that the cities of the Randstad would grow together due to the predicted population growth. New towns had to contribute to the accommodation of inhabitants from the big cities in the Randstad. In this, the Green Heart had to stay intact. In 1958, the 'Werkcommissie Westen des Lands' laid the foundation for the new cities in the Netherlands. New towns had to be built around 'donor cities' (Nio, 2016).

Because in the polder it was not possible to build on an existing situation, people in Almere were forced to think about what a new city had to be. The planners and designers of Almere broke with the ideas of the CIAM. After the realisation of the Bijlmermeer, planners turned away from large-scale top-down planning. The concept of Almere was based on both traditions and new developments. The flexible design of a poly-centric city was the answer to the uncertainty of future developments. By building up in several centres, the city could serve both 100,000 and 250,000 inhabitants. There was a pragmatic focus on the urbanization process or growth model for urbanity. The city had to gradually become more urban with amenities, a city centre and a more diverse population (Nio, 2017).

However, meeting the housing needs of the middle class, in the North Wing of the Randstad, the new housing stock had to consist of ninety percent single-family houses. This objective was in line with the anti-urban sentiments of the directors of the 'Rijksdienst voor de IJsselmeerpolders'. Almere did not want to compete with Amsterdam or Haarlem in urbanity. As an egalitarian city for the common man, it had to reflect on older suburban areas such as Het Gooi. They started with the construction of social housing. The first homes in Almere Haven were completed in 1976. Mainly inhabitants of Amsterdam which lived in areas where urban renewal was about to take place, settled in Almere (Nio, 2016).

The new towns had to become improved suburbs, more urban in particular. It was about the contemporary design suburban urbanity. Besides the objective of meeting the housing needs, the project of the new town should not only lead to the construction of housing. The aim was also to create and facilitate public spaces, libraries, shops, stations and cinemas (Nio, 2016).

But, opinions on what kind of a city Almere should be differed. The increased mobility required the construction of infrastructure, new towns were considered part of an urban region where many residents were commuters. A service economy and facilities for mass culture such as shopping centres that would also attract visitors from outside had to be fitted in the centres of the cities. The assignment was a suburban city with facilities, employment and single-family homes (Nio, 2016).

Doubt

The new city of Almere was not enthusiasti-



Image 34: Information office Almere (Potuyt, 2013)



Image 35: 1978 start development Almere Stad (Nobelhorst, nd.)



Image 36: Development Almere (Gemeente Almere, n.d.)



Image 37: Almere 40 jaar pioneren in de polder (Varia, 2016)



Image 38: 1976 first key (Nobelhorst, n. d.)

cally received by the community. The suburban city was miles away from the lively and heterogeneous city with public spaces that was rediscovered by a young generation of designers and planners around the 1970s. The criticism focused on the suburban program of Almere. The optimism of the sixties made way for doubt in the early seventies. More and more objections arose against the growth centres policy. Urban renewal was given priority. The search for a redefinition of urbanity ended with the revalidation of the existing city in the 1970s (Nio, 2016).

Urbanity was no longer equated with an urban way of life, but with the characteristics of a space in a neighbourhood. An attempt was made to copy a small-scale urbanity to the growth centres. The small scale of Almere Haven is at odds with the modernist, large-scale planning traditions with which the design for Almere began. The scale reduction lead to thinking in terms of neighbourhoods, and no longer in terms of the region, city and urban culture (Nio, 2016).

Real city

Almere had 40,000 inhabitants in the mid-1980s. The city centre was small, however there was room for future growth. The city hall and the hospital were built in the centre of Almere Stad in the second half of the 1980s. In 1987 the train connection from Amsterdam to Almere was completed. The Almere municipality, which was independent from 1984 on, was confronted with the question of what kind of a city Almere actually is. There was still much needed to become a 'real city'. The vibrancy of the city and the diversity of the housing supply fell short. The formal status of growth centres came to an end and the new municipality of Almere was responsible for further development. The transition from a growth centre status to a 'normal' municipality took place earlier than in other comparable new towns. The awareness that the new city was not yet finished led to questions about identity and urbanity. The proximity of Amsterdam with its wealth of facilities in education and recreation stood in the way of Almere's ambition as a complete urban settlement. The Structure Plan of 1984 aimed to further develop urban culture. The focus was on the centre of Almere Stad, here urbanity had to be expressed (Nio, 2016).

With the motto 'complete city', the municipality of Almere now indicates that it wants to develop more like the traditional Dutch city. At the same time, urbanity and suburbanity no longer coincide in the Structural Vision (2009). Both are strengthened as two poles of one and the same city. The aim is to break through the average suburban living environment by adding more urban and rural living environments. New cities such as Almere cannot be understood as the density and function mix from classical criteria of urbanity. They originated and grew in the tension between urbanity and suburbanity (Nio, 2017).

Living environments

Almere is equal to living; it is in the genes of the city. This is not surprising, because the city derives its origin from an urgent need for homes in the Randstad. Almere fulfilled the function of overflow location for Amsterdam. Central in the design of the city is the optimization of factors that determine living comfort. For example, an almost ideal living environment must be created that is accessible to all layers of the population: a twentieth-century living idyll. In addition to the inevitable and strategic emphasis on single-family houses, the city is also aiming to build more expensive housing in order to create a stimulating environment that will attract future residents who have greater spending opportunities. However, the reality appears to differ from the theory on this point. This resulted in an adjustment of the expectations for a mixed population composition. The majority of the interested parties are young lower and middle-educated employees, who want a single-family house with a garden for an affordable price. From that moment on, Almere is developing vigorously. The city has a steady production of popular and high quality single-family low-rise houses. There is little need to experiment (Berg et al., 2007).

Over the past 30 years, more diversity in housing requirements has emerged. Not only has the disposable budget increased considerably due to the increased prosperity, the future resident also behaves more and more like a capricious and volatile consumer who is influenced by all sorts of impulses in determining the desired living environment. The emphasis is increasingly on the house and less on the living environment, partly due to the individualisation and increasing mobility in society. Housing is no longer a need but has become an image (Berg et al., 2007).

Almere wants to break with its one-sided suburban development. In recent years, there has been a focus on greater differentiation in the living environment on various fronts. It is a parallel search for more collectivity, more urbanity and more private commissioning. Private commissioning and associated collective variants and forms of consumer-oriented construction, will have to give an important qualitative boost to the residential city of Almere in the coming decades (Berg et al., 2007).

Suburban urbanity

Almere is a pragmatic suburban city. Residential environments are hierarchically set up according to the district-neighbourhood-residential areas diagram. Within that scheme, a theme has been devised for each neighbourhood (Nio, 2016).

In order to keep the new cities attractive, accessibility is also desirable in terms of employment, urban locations and an attractive leisure landscape. Because, Almere is located quite close to Amsterdam, there is always a competition. There is less employment in Almere and there are fewer regional facilities. It lacks the historical and spatial layering of the other new cities (Nio, 2017)

Due to the objective of realizing 60,000 new homes until 2030, Almere is paying a lot of attention to residential experiments such as Het Homeruskwartier and Oosterwold. But a collection of houses, however renewed in a process sense and self-built, does not automatically lead to a more attractive suburban city (Nio, 2017).

The essence of the five-core poly-centric city model is the combination of relatively small units with direct access to the outside space, while having the benefits of a city of 250,000 inhabitants. In Almere they try with this "key" to achieve the suburban urbanity. The city will consist of cores from which direct contact with nature is possible and where the larger urban and more specialized facilities are available at short distance. The objectives are to minimize the distance between home and facilities, recreational facilities, including green areas, and employment (Nio, 2016).



Image 39: Cauliflower neighbourhood (aerophotostock, 2014)

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Existing patterns **100**
Activity patterns **106**

SITUATION

Introduction
De Wierden, De Hoven & De Werven

This chapter focuses primarily on mobility and activity patterns - because other health aspects are not needed to be mapped and/or are not mappable. The mobility and activity patterns, on the other hand, still have to be analysed.

The first areas addressed are a part of Almere Haven in the south of Almere. 3 neighbourhoods have been selected, namely De Wierden, De Hoven and De Werven. The neighbourhoods count respectively 3,769, 2,435 and 2,776 inhabitants. The city of Almere has in total 203,990 inhabitants and will grow till 2040 with 78,000 inhabitants and 60,000 houses compared to 2010 (Provincie Noord-Holland, 2017).

In Almere Haven the 'Projectbureau' strove for the conviviality, liveliness and the varied image of an old Dutch town. Important characteristics of Almere-Haven are: integration of functions, walkability, encountering, hospitality, high residential densities and a low building height. The design for Almere Haven is based on the characteristics of Dutch towns. References are the historical centres of Edam and Hoorn. The small scale of Almere-Haven is contradictory with the modernist, large-scale planning traditions with which the design for Almere began. The scale reduction involved thinking in terms of neighbourhoods, and no longer in terms of the region, city and urban culture (Nio, 2016).

Almere Haven is the oldest district of Almere. With the exception of the De Velden and Overgooi districts, Almere Haven was built in the period 1976-1990. Characteristic of Almere Haven is the green, small-scale, village structure with woonerven from the seventies. This small scale with inner courtyards creates a distinctive living environment compared to the rest of Almere. Another striking spatial feature is the water, both visible in small water structures in the district and in the Havenkom on the Gooimeer. The Havenkom is the centre of the district. The marina also attracts visitors from far outside Almere in the summer (Gemeente Almere, n.d.-b).

The oldest districts of Almere Haven exist for about 40 years. In these neighbourhoods, both buildings and public spaces are subject to aging and physical wear (Gemeente Almere, n.d.-b).

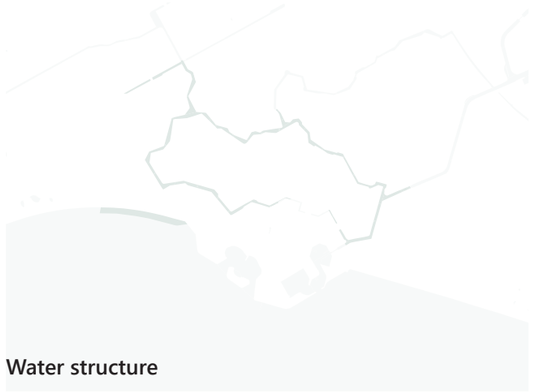
In Almere Haven the neighbourhoods live a relatively high amount of elderly (65+). Almere haven is ageing, in itself that is not so surprising, because Almere Haven was built first (Platvoet, 2009). The group of people between the 44 and 65 years old is somewhat smaller and the other age groups are comparable to the average in Almere.

The income in the three neighbourhoods in Almere Haven is lower compared to the average of Almere.

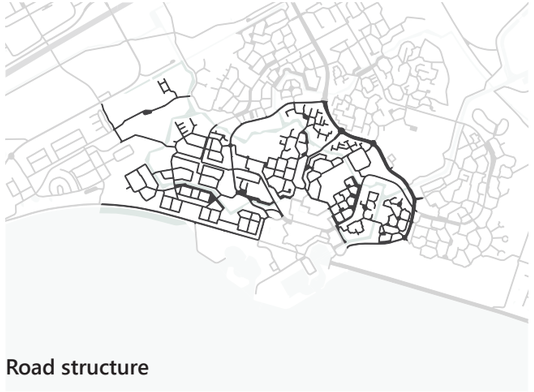
De Wierden, in Almere Haven, has 1,617 homes. 67% of the number of houses is social housing. Almere Haven was the first part which was built of Almere, De Wierden was built between 1980 and 1990. The average value of the houses in De Wierden is €136,000, quite some lower than in the two neighbourhoods of Almere Stad. 60% of the houses are single family houses, 40% of the stock are multi-family houses. 99% of the housing stock is inhabited, only 1% is vacant



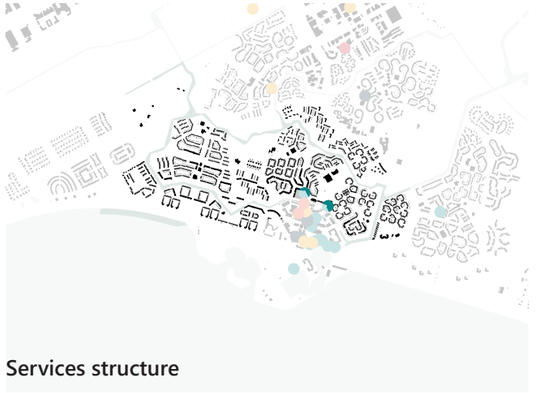
Image 40: Almere Haven: De Wierden, De Hoven, De Werven (adjusted image: Google Earth, 2018)



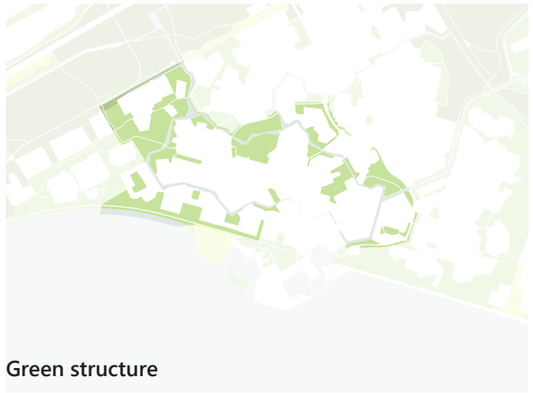
Water structure



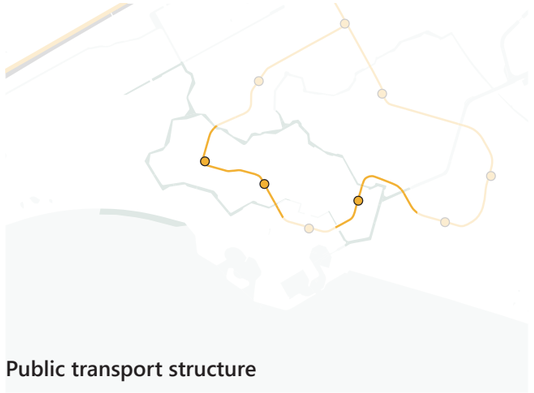
Road structure



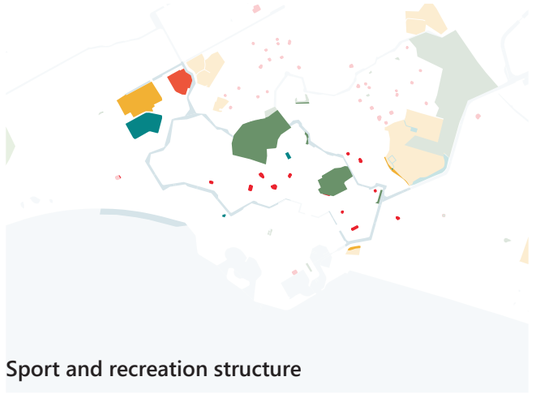
Services structure



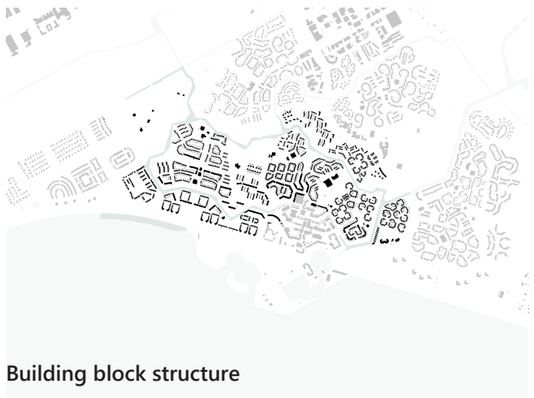
Green structure



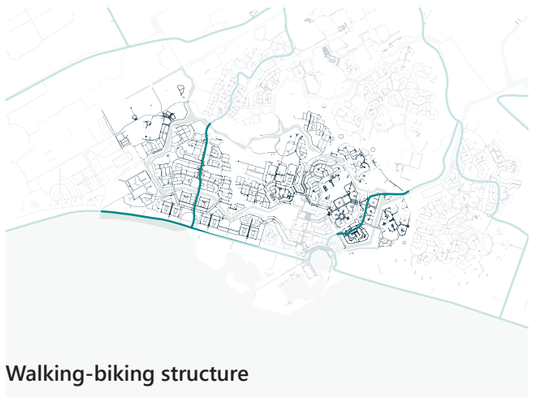
Public transport structure



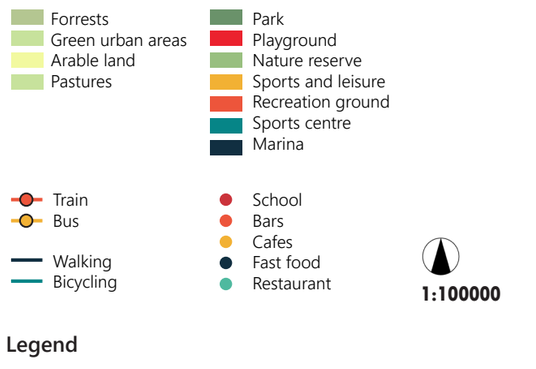
Sport and recreation structure



Building block structure



Walking-biking structure



Legend

Image 41: Structures Almere Haven (own image, information from: ESRI, 2018)

(CBS, 2017).

De Hoven counts 1,130 homes, of which 55% is social housing. De Hoven is built between 1975 and 1980. The average value of the houses in De Hoven is €148,000, which is somewhat higher than the houses in De Wierden. 49% of the houses are single family houses, 51% of the stock are multi-family houses. This share in multi-family houses is the highest of the selected neighbourhoods. 98% of the housing stock is inhabited, only 2% is vacant (CBS, 2017).

De Werven counts 1,325 houses, of which 51% is social housing. De Werven was built between 1975 and 1980. The average value of the houses in De Hoven is €141,000, which is somewhat higher than the houses in De Wierden. 65% of the houses are single family houses, 35% of the stock are multi-family houses. 98% of the housing stock is inhabited, only 2% is vacant (CBS, 2017).

The relocation tendency of the residents of Almere Haven is not big, compared to the rest of Almere. People feel bound to their district. But if they move, they will go to a house in another part of the city. This is probably due to the unilaterally composition of the stock: there are only a few possibilities for the wealthier inhabitants of Almere Haven. Most people move away from De Wierden and De Werven, the neighbourhoods with the most unilaterally composed and cheap housing stock. The departures are mostly two-person households with a middle-high income. Also, a lot of people move to De Wierden and De Hoven because of the cheap housing stock. This unilaterality means that there is a theoretical housing surplus in Haven: more people want to leave Almere

Haven than that people want to live there. Almere Haven is the only district with such a virtual housing surplus (Platvoet, 2009).

The objective "priority for slow traffic" was translated into a system of slow traffic routes oriented radially at the centre (located at the port). Radial, because they form the shortest, and therefore attractive slow traffic routes. This radial structure also fitted in with the desire to differentiate the urban landscape by densifying the buildings along those routes (which at the same time aimed at shelter from wind and weather, and thereby stimulating cycling). The OV track (bus lane) was designed by a looped route with a connection on the north-side towards the central core (Almere Stad). Initially also with two foothills to the east and west, later the loop has been enlarged to both sides, so also those neighbourhoods could be accessed by one loop, to prevent unnecessary, extra bus lines for the foothills. Almere Haven would become a core of 25,000 inhabitants, so it was clear from the outset that core would only get one connection on the A6, the Noorderdreef, with overfly crossings for slow traffic. The tree structure of Almere Haven was the result of the longing for small scale during that time (as a counter reaction to Bijlmer-style high-rise districts elsewhere in the country) (Gemeente Almere, 2006).

In the barren windy polder land, "shelter" was an important theme in urban planning. In Almere Haven, the cyclist was provided with narrow urban bicycle streets. Despite the routes were well sheltered, they were not attractive. Residents got to cycle at about 3 to 4 metres along their front door. Cyclists could not cycle smoothly here, before you knew it, you had a dog or a child in front of your bike. The winding cauliflower structure made way-finding difficult. In the new planning areas of Almere, the bicycle routes therefore became more spacious stretched, and straighter, often bundled with water, bus lanes, railway or just on the streets (Dienst Stedelijke Ontwikkeling Almere, 2013).

A large part of the weaknesses and threats in Almere Haven is concentrated in the inner ring: De Wierden, De Werven, De Hoven and Centrum. Various aspects, such as aging, household dilution, loss of benefits and poverty, reinforce each other negatively. In 2012 De Werven, De Hoven and Centrum were analised. This showed that attention is also needed in these neighbourhoods for the socio-economic situation (Gemeente Almere, n.d.-b)

The most important thing in Almere Haven is improving the socio-economic position of a part of the population, realizing more diversity in the housing stock and a well-functioning facilities structure. The focus is on the centre of Almere Haven and the neighbourhoods that together with the centre form the inner ring of Almere Haven (Gemeente Almere, n.d.-b).

In Almere Haven there are a number of small business parks and one large business park (De Steiger). In addition, the Almere Haven Centre is the economic heart of Almere Haven. Relatively isolated, in the east of Haven, the business park Stichtse Kant is still being developed.

Vacancy of retail space in Almere Haven is 10 percent, which is higher than in the other city districts (with the exception of Almere Poort). In Almere Haven Centre, the picture is slightly more positive, also compared with the other district centres. Nevertheless, many retailers and shop owners have a hard time. In the centre there is also a lot of vacancy in outdated office buildings.

De Steiger industrial estate is clearly facing vacancy and impoverishment. The area is influenced by the widening of the A6 and the Floriade development (Gemeente Almere, n.d.-b).

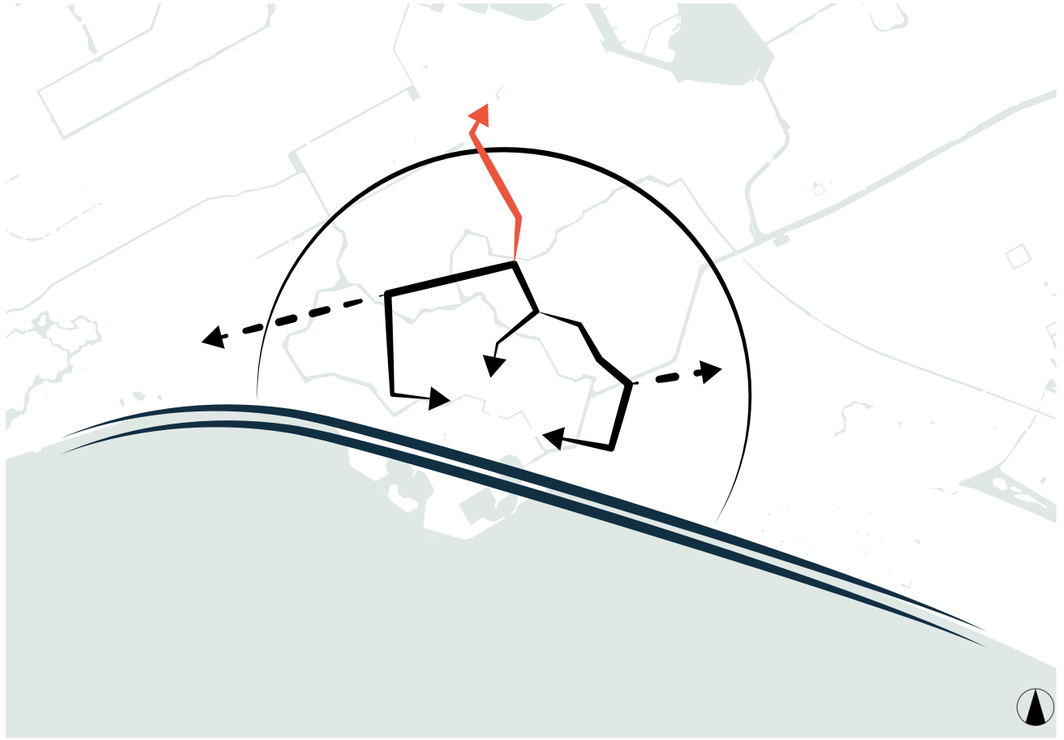


Image 42: Concept structure lanes Almere Haven (own image, information from: Gemeente Almere, 2006)

Introduction Filmwijk, Danswijk

The second area addressed in the east of Almere Stad. 2 neighbourhoods have been selected, namely Filmwijk and Danswijk. Filmwijk counts 10.515 inhabitants, this is the biggest selected neighbourhood. In Almere Stad does Danswijk count 5,840 inhabitants.

The proximity of Amsterdam with its wealth of facilities in education and recreation hindered Almere's ambition as a complete urban settlement. The Structure Plan of 1984 aimed for further development of the urban culture. The accent was on the centre, here urbanity had to be expressed: Almere Stad with its urban facilities and location around the central lake is seen as the culmination point of urban lifestyle and design in Almere. In the new residential areas more, attention was paid to public space. The urban spaces and elements returned to Almere Stad as the park, boulevard, square and straight streets where the principle of separate traffic flows was released again (Nio, 2016).

In Filmwijk the percentage of young children is slightly lower than the average in Almere. The percentage of inhabitants between the 44 and 65 years old is higher than in the rest of Almere. Both in Filmwijk and in Danswijk is the share of inhabitants who are between the 15 and 24 years old bigger compared to the average in Almere.

The income of the inhabitants of Filmwijk and Danswijk it is comparable with the average. In both Filmwijk and Danswijk are more businesses settled than in Almere Haven (CBS, 2017).

Filmwijk counts 4,352 homes, of which one third is social housing. The plans for building the site to the east of Almere-Centrum arose in the eighties. By 1996 mainly all houses were finished. The average value of the houses in Filmwijk is €187,000. 71% of the houses are single family houses, 29% of the stock are multi-family houses. 98% of the housing stock is inhabited, only 2% is vacant (CBS, 2017).

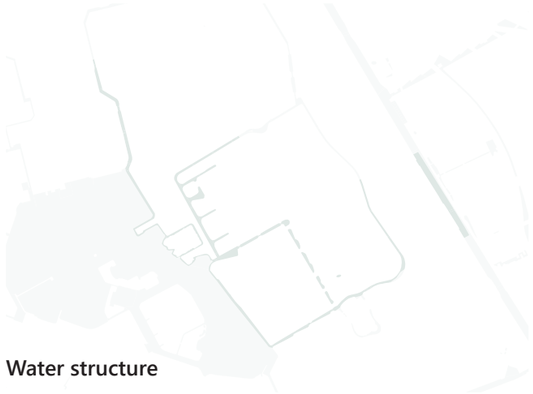
Danswijk has 2122 homes, of which 23% is social housing. As well as Filmwijk, Danswijk is finished by the end of the 1990s. The average value of the houses in Danswijk is €163,000, somewhat lower than in Filmwijk. 83% of the houses are single family houses, 17% of the stock are multi-family houses. 99% of the housing stock is inhabited, only 1% is vacant (CBS, 2017).

Almere Stad has a high 'stay rate' compared to Almere Haven and Almere Buiten: 39% of the movers remain in the district. The most homes are located in Almere Stad, this allows house hunters to choose from an extensive range. Almere Stad is also loved by people from other parts of the city. Popular neighbourhoods are: Centrum, Filmwijk, Parkwijk, Literatuurwijk and Noorderplassen. The eastern part of town is characterized by a better position on the housing market than the western part. The demand for housing outweighs the supply: there is a - theoretical - housing shortage of 1,750, if there were no new construction sites.

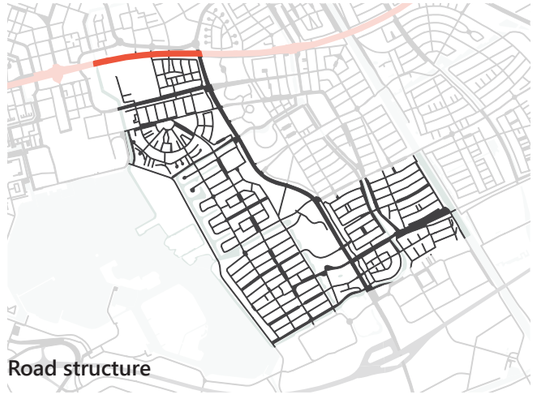
The Stripheldenbuurt is by far the most popular among movers from the city to another part of the city: because this is a relatively new neighbourhood. Also, Almere Poort is and will become a popular destination for residents of Stad (Platvoet, 2009)



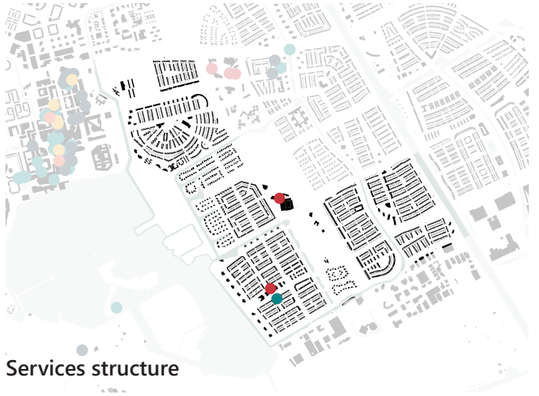
Image 43: Almere Staa: Filmwijk, Muziekwijk (adjusted image: Google Earth, 2018)



Water structure



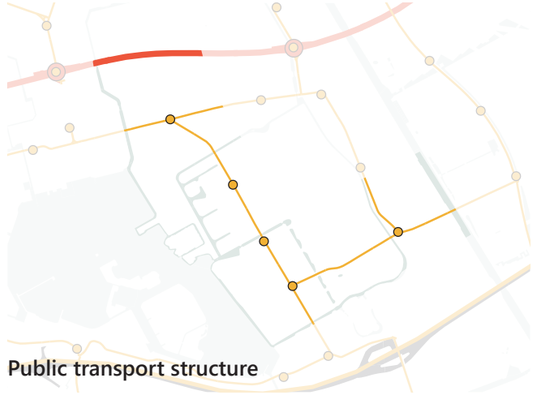
Road structure



Services structure



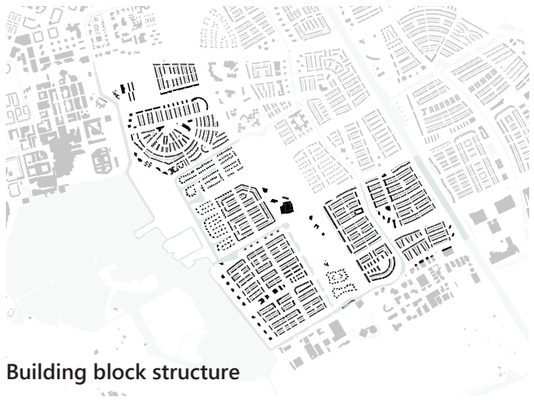
Green structure



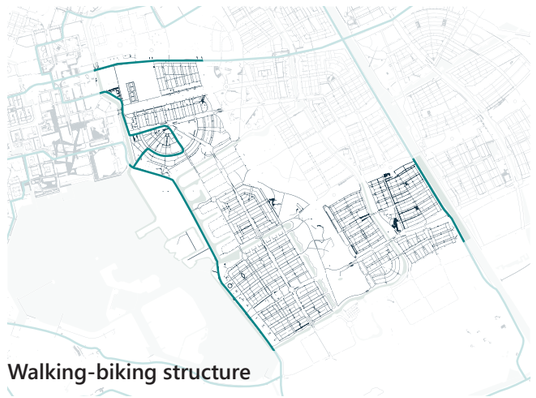
Public transport structure



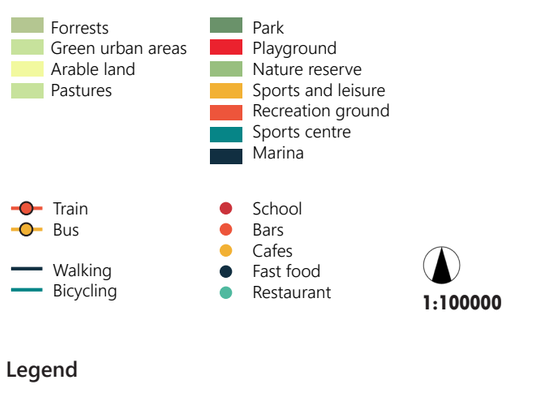
Sport and recreation structure



Building block structure



Walking-biking structure



Legend

Image 44: Structures Almere Stad (own image, information from: ESRI, 2018)

Almere Stad, the central core, is of a completely different scale as Almere Haven, meant for 100,000 inhabitants. It is the central core of the multi-core concept. Central through the neighbourhoods were public transport jobs planned, on the one hand focused on the centre, on the other hand on the surrounding centres. Both public transport and slow traffic needed fast, short and direct connections between the centres and the surrounding centres. The city therefore received two axle systems: that of the polder and a new direction diagonally. This created entire neighbourhoods diagonally oriented towards the centre, as 800-meter-wide urban bands (because of a maximum of 400 m walking to a stop) around the public transport connections (Gemeente Almere, 2006).

Spatially, the bus concept determined the design of Almere Stad. Everything else was added later: the motorways, cycle paths, canals, centres, working areas. The principles for car traffic such as in Almere Haven (avoid unnecessary - through - car traffic by reversing traffic for cars and directly for slow traffic) also were applied in the other cores but were of a different scale as in Almere Haven. The urban band Stad and Buiten 'asked' for a ring road. For Almere Stad, a system of loop-shaped driveways with a limited number of links has been developed, in order to prevent through traffic and unnecessary load on the internal road network as much as possible. The loops were aimed at the periphery, to unwind the traffic as smoothly as possible to the ring around the city (Gemeente Almere, 2006).

The combination with the diagonal

axes and the orthogonal system of axes of the polder led in design to main road sections that each time 45 degrees. This resulted in the same criticism as in Haven: a difficult orientation (Gemeente Almere, 2006).

In the centrally located Almere Stad district, the choice was made to structure the neighbourhoods and cycle routes diagonally at the main centre and the NS stations. Freestanding routes were equipped with comfortable pavement and attractively furnished with plants. This resulted in an ideal-typical bicycle network, which meets all the traffic requirements of cohesion, directness, comfort and safety. The competitive position of the bicycle in relation to the car is thereby permanently anchored in the DNA of the city (Dienst Stedelijke Ontwikkeling Almere, 2013).



Image 45: Concept structure lanes Almere Stad
(own image: information from: Gemeente Almere, 2006)

Existing patterns

The different characteristics of Almere are determined by the following four main themes:
• Landscape: parks, lakes and forests
• Urban functions: the main and sub centres
• The large industrial areas along the A6
• The infrastructural landscapes: A6, ring-way, railway zone

At an urban level, the central east-west oriented zone within the ring-way and the A6 contain the most important urban area functions. As a result, this zone can be designated as the zone with the largest urban dynamics, making it possible to see Almere Stad and Almere Buiten as a belt city. A 'fast' zone can be distinguished along the national highway A6. The large business parks give this zone a regional function. The northern zone, with the Noorderplassen and the Lepelaarsplassen in which green, water and buildings are interwoven with each other, can be characterized as a 'wet' zone. Opportunities for recreation and extensive residential and work areas are abundant here. Almere Haven, Overgooi, Almere Hout and the forest area between Hout and Overgooi are part of the southern recreational/rural zone. The A6 acts as a barrier for this zone, making these areas isolated from the city centre. It is still questionable what the effect of the development of Almere Hout is on the green image on the south side of the city (Gemeente Almere, 2006).

Almere has a wide variety of characteristics, but the lane structure barely aligned to this. Differentiation of the lanes has been omitted (Gemeente Almere, 2006).

The map in image 47 shows on which axes most urban developments and the largest traffic and transport movements will occur.

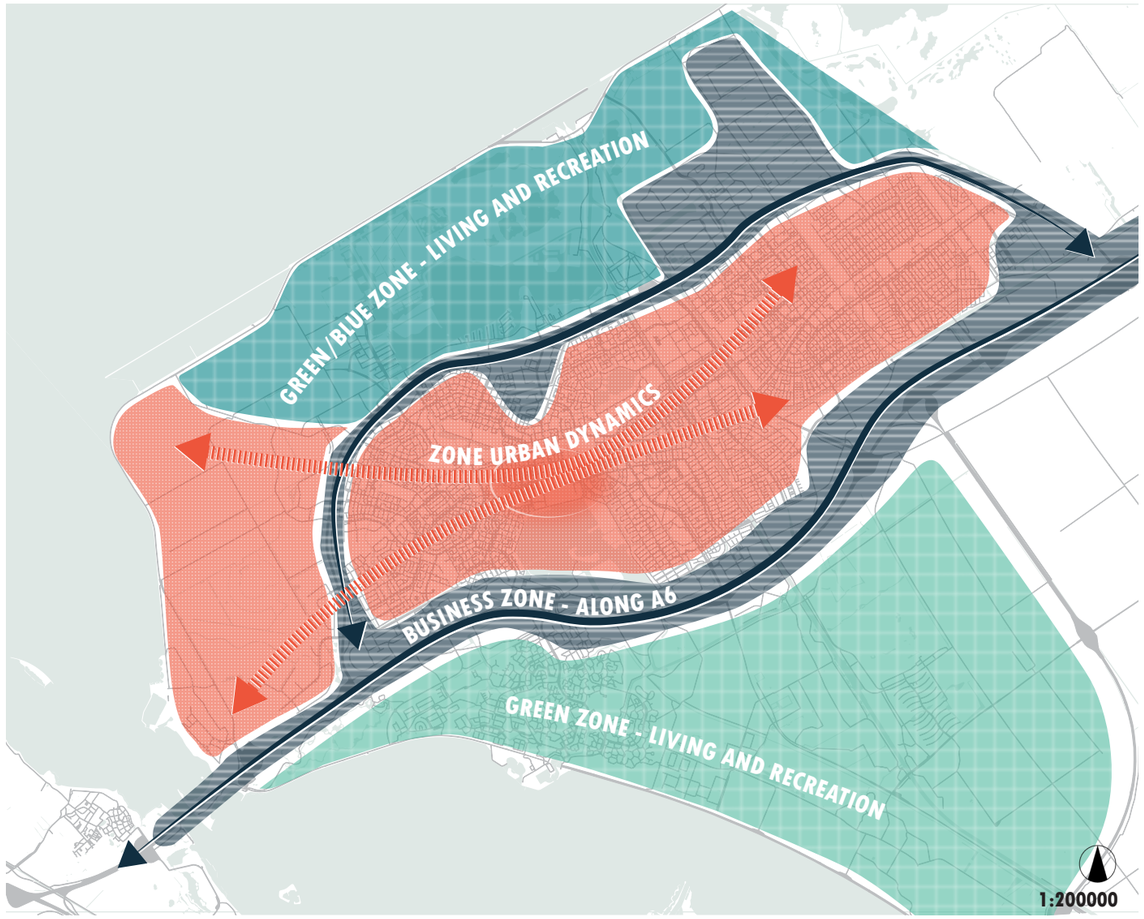


Image 46: Urban dynamics
(own image, information from: Gemeente Almere, 2006)

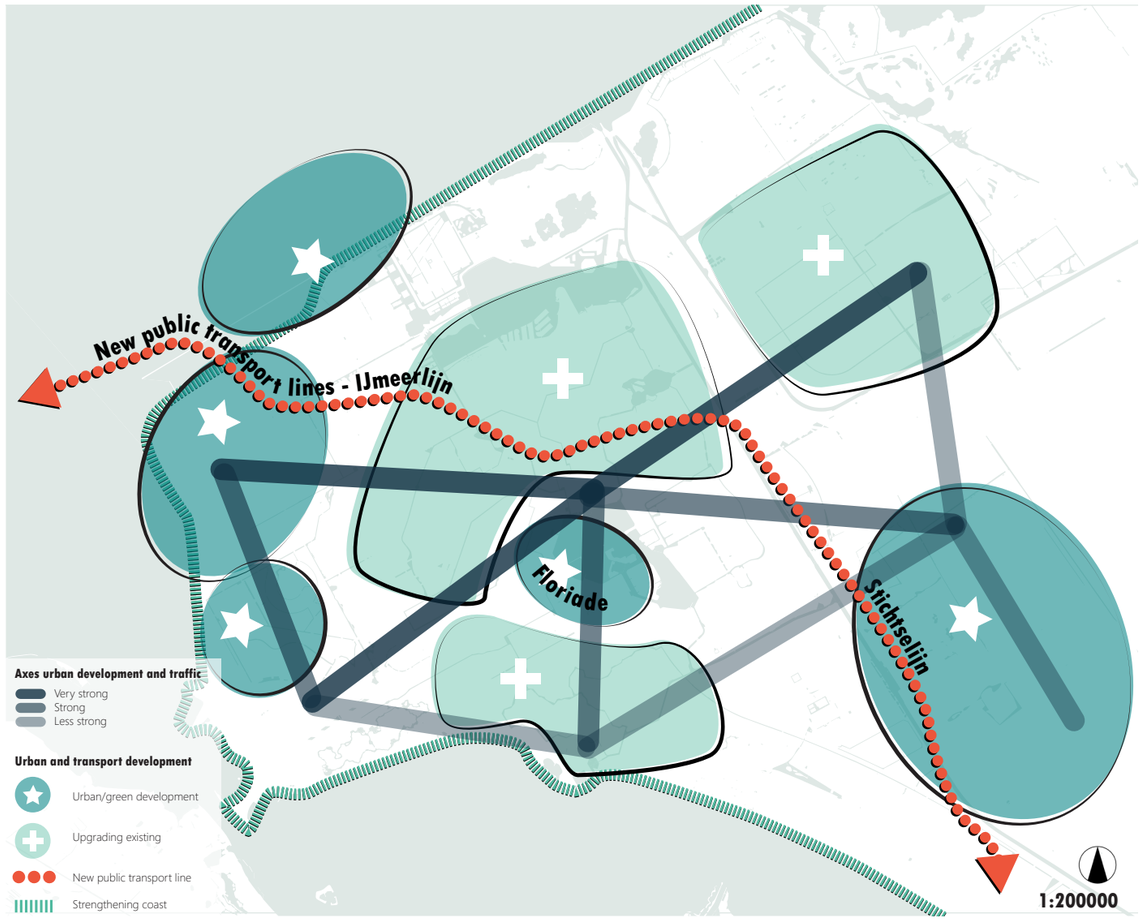


Image 47: Development
(own image, information from: Gemeente Almere, 2006)

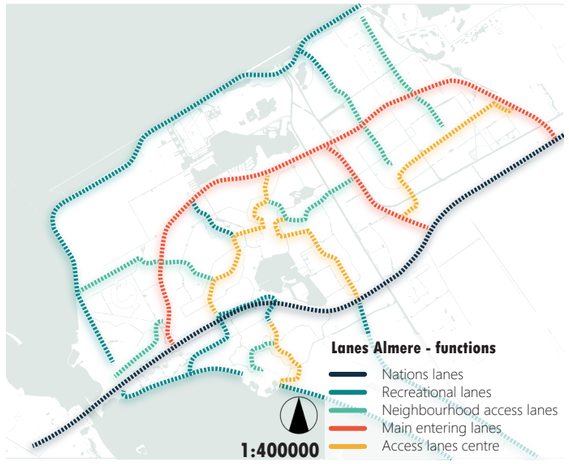


Image 48: Function lanes
(own image, information from: Gemeente Almere, 2006)

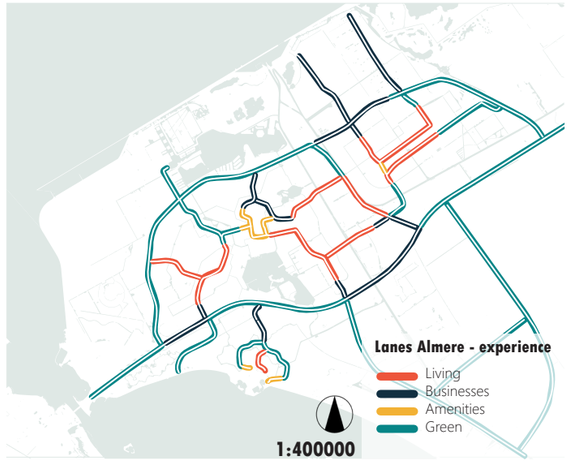


Image 49: Experience lanes
(own image, information from: Gemeente Almere, 2006)

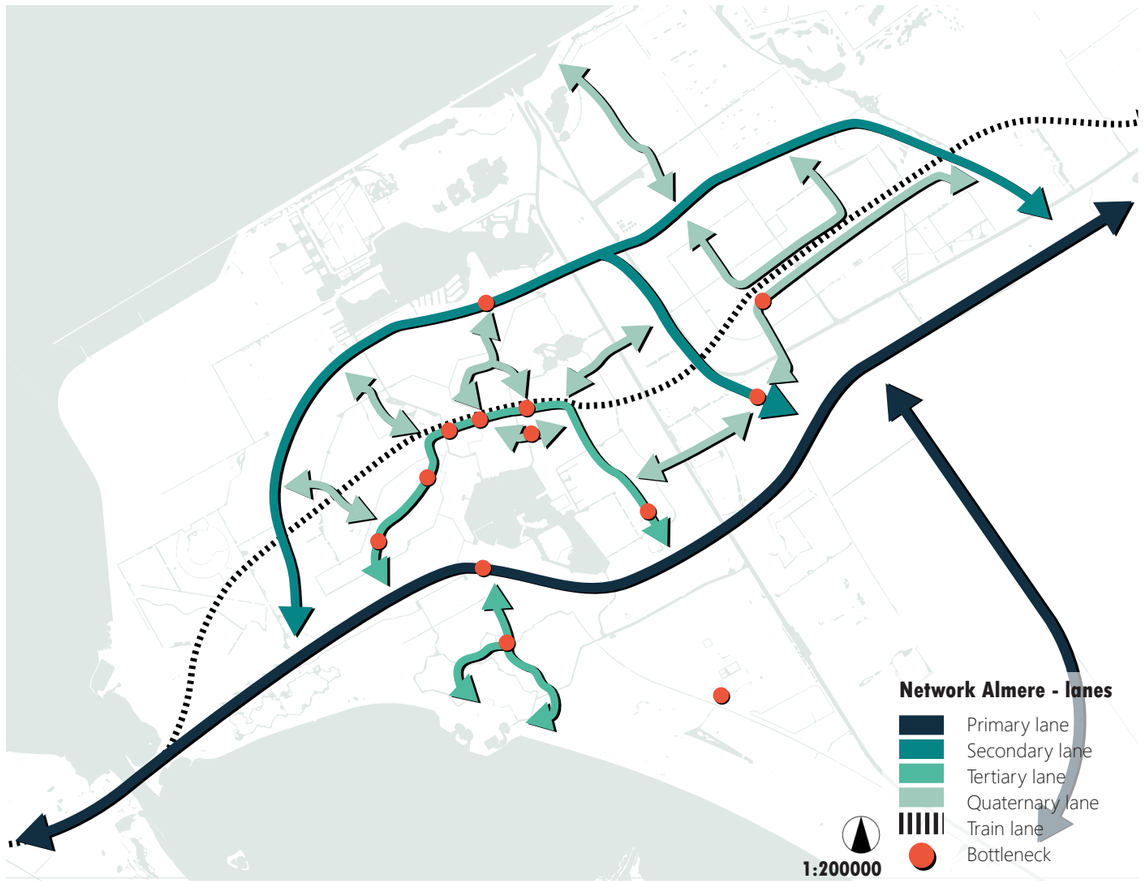


Image 50: Network of lanes
(own image, information from: Gemeente Almere, 2006)

The current lane structure does not match with these relationships everywhere. Particularly between the existing centres of districts some missing links can be distinguished. For example, between Almere Haven and Almere Stad.

Besides the intensity of traffic movements the map also shows the new plan for extending the public transport lanes to Amsterdam and towards the province of Utrecht, to create a better accessibility. In the short term, the capacity of the corridor A6-A1-A9-A10 and the Flevolijn will be expanded. The widening of the A6 improves the accessibility of the city and makes new developments possible. The number of trains on the Flevolijn increases from eight to twelve per hour in both directions. The Hanzelijn Almere also links with Zwolle. With this, Almere is no longer on a dead-end railway. It will be given a place in the network between the Randstad and the North of the country. Almere is connected to the Utrecht region by capacity expansion of the A27 and the construction of the Stichtse line. This Stichtse line is initially developed as a high-quality public transport connection. In time, this line will be upgraded to a rail connection (Communicatie Almere 2.0, 2012).

For a strong connection with the Amsterdam metropolitan region, the construction of the IJmeer line is crucial. The IJmeer line forms the connecting link in the double city of Amsterdam - Almere and is the most important carrier for a growing Almere and the metropolis formation. The calculation of the transport value of the IJmeer line shows that by 2030 three times more passengers will use public transport every day. The number of public transport passengers rises to 130,000 per day. The IJmeer line makes Almere a public transport city. Without the IJmeer line, there is a threat that Almere will stay a classic car city (Communicatie Almere 2.0, 2012).

To maintain the openness of the IJmeer, the IJmeer line near Almere will disappear into the tunnel just below the dike under water. This requires an outer dike island. In addition to the IJmeer line, investments will have to be made in the ecological quality of the IJmeer and Markermeer. The continuously re-suspending sludge causes further deterioration of nature. In order to stop the sludge, wetlands must be built on a large scale. Situation between the North Holland coast and Almere has a positive effect on the reduction of the sludge flow. The combination of the island for the IJmeer line and the construction of wetlands leads to a special opportunity to combine city and nature. At Almere IJland, a concentration of buildings is being built around the station in front of the IJmeer line (Communicatie Almere 2.0, 2012). Besides, new housing and developing locations are marked, including areas which need to be strengthened.

In image 50 is the lane structure of the whole city shown. The urban band Stad and Buiten 'asked' for a ring road. For Almere Stad, a system of loop-shaped driveways with a limited number of links has been developed, in order to prevent through traffic and unnecessary load on the internal road network as much as possible. The loops were aimed at the periphery, to unwind the traffic as smoothly as possible to the ring around the city. In Almere Haven the objective "priority for slow traffic" was translated into a system of slow traffic routes oriented radially at the centre (located at the port). Radial, because they form the shortest, and therefore attractive slow traffic routes. The red circles indicate the bottlenecks (Gemeente Almere, 2006).

Image 51 shows an overview of the intensity of the road and bicycle network. Besides, it shows the parking capacity and accessibility to each train station by active travel. In the red boxes is displayed what the scores for the public transport, cycling, walking and sustainable transport are. The blue boxes show the choice for each mode of transport.

The choice of mode of transport shows that the share in bicycle use is very low, while the bicycle facilities do score well. The total share of non-car use is low, despite the relatively good share of buses in Almere. The public transport infrastructure also scores low. In spite of the bicycle and bus infrastructure, the car is dominant due to the broad layout with low building densities, large internal distances and good car infrastructure, with the car having the advantage in terms of travel time (Voerknecht & van Bokhorst, 2018).

The bicycle network in and around Almere centre is most intensively used. It is less used in Almere Haven. Also, the proximity of, by active transport approachable, trains stations is low in Almere Haven. In Almere Haven people are more dependent on the car than in the rest of the city.

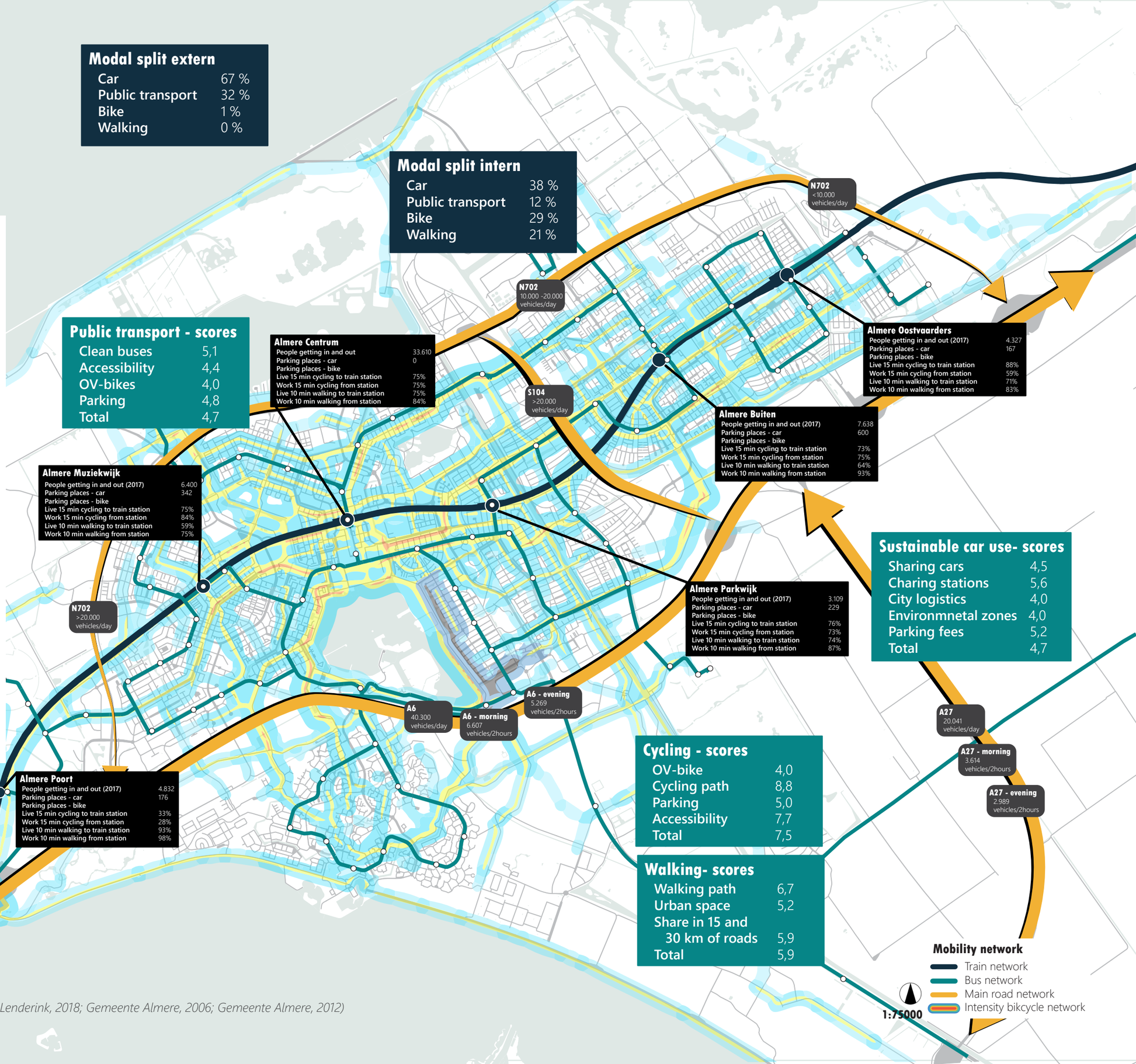


Image 51: Mobility network
(own image, information from: Steneker, de Haan, & Klein-Lenderink, 2018; Gemeente Almere, 2006; Gemeente Almere, 2012)

Activity patterns

This chapter focussed on the mobility and activity patterns of the city of Almere to see what current patterns are and where opportunities might lie. This paragraph elaborates a little further on the model split in the city. Focussing on why less people use active modes for travelling compared to other (same sized) cities.

Almere is the safest bicycle city in the Netherlands. The city has a network of more than 500 kilometres of cycling routes, mostly free and asphalted. Cyclists on the main bicycle network have priority and all intersections with main roads are at ground level. Nowhere you cycle faster and more comfortable. Many hundreds of bridges and tunnels make Almere a barrier-free bicycle city. The extensive nature reserves, the water and the wide range of high-profile architecture make recreational cycling in Almere a special experience (Dienst Stedelijke Ontwikkeling Almere, 2013).

In the barren windy polder land, "shelter" was an important theme in urban planning. In Almere Haven, the cyclist was provided with narrow urban bicycle streets. Despite the routes were well sheltered, they were not attractive. Residents got to cycle at an offset of about 3 to 4 metres in front of their door. Cyclists could not cycle smoothly here, before you knew it, you had a dog or a child in front of your bike. The winding cauliflower structure made way-finding difficult.

In the centrally located Almere Stad district, the choice was made to structure the neighbourhoods and cycle routes diagonally at the main centre and the NS stations. Free-standing routes were equipped with comfortable pavement and attractively furnished with plants. This resulted in an ideal-typical bicycle network, which meets all the traffic requirements of cohesion, directness, comfort and safety. The competitive position of the bicycle in relation to the car is thereby permanently anchored in the DNA of the city (Dienst Stedelijke Ontwikkeling Almere, 2013). In the new planning areas of Almere, the bicycle routes therefore became more spacious stretched, and straighter, often bundled with water, bus lanes, railway or just on the streets (Dienst Stedelijke Ontwikkeling Almere, 2013).

However, in Almere Stad the combination with the diagonal axes and the orthogonal system of axes of the polder led to a design of the road structure that each time turned 45 degrees. This resulted in the same critique as in Almere Haven: a difficult orientation (Gemeente Almere, 2006).

The choice of mode of transport shows that the share in bicycle use is quite low, while the bicycle facilities do score well. The total share in non-car use is low, despite the relatively good bus infrastructure in Almere. The public transport infrastructure also scores low. In spite of the bicycle and bus infrastructure, the car is dominant due to the broad layout with low building densities, large internal distances and good car infrastructure, with the car having the advantage in terms of travel time (Voerknecht & van Bokhorst, 2018).

Concluding, Almere is a city with a high level of bicycle facilities (see image 52). Despite the extensive bicycle network, bicycle use in Almere is still 3% behind on the national average. The cause is multifarious: competitive public transport, large distances, a relatively high

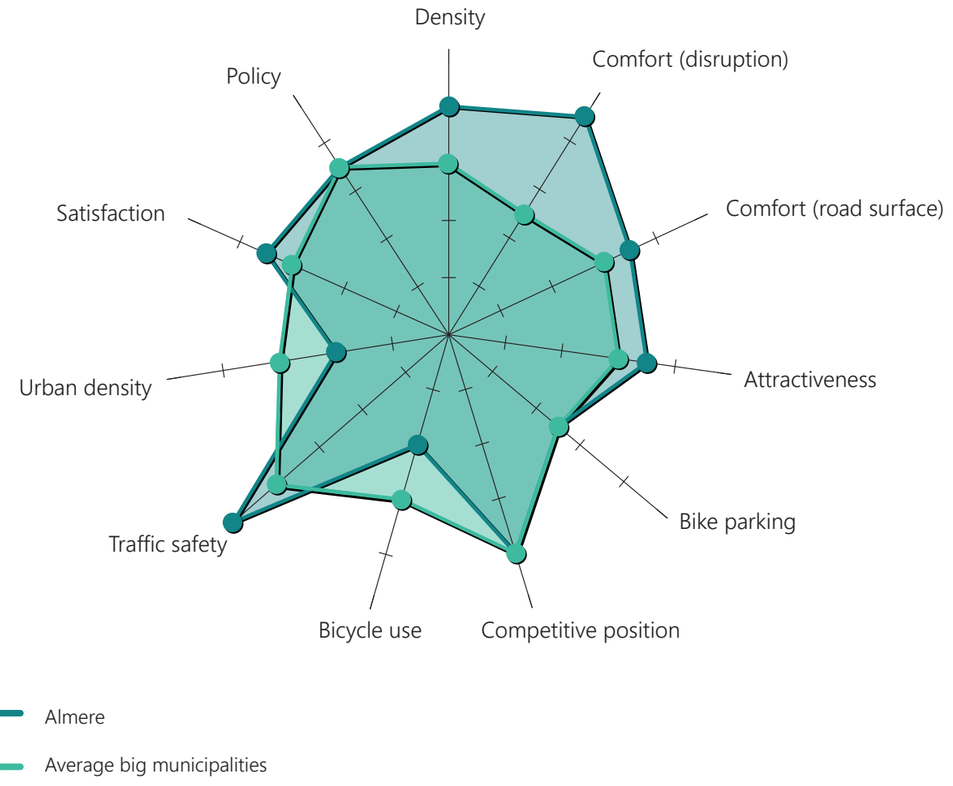


Image 52: Biking diagram (own image, information from: Dienst Stedelijke Ontwikkeling Almere, 2013)

number of commuters and a low number of students. Stimulation of bicycle use therefore also has several aspects.

Because the number of jobs in the city has lagged behind the number of homes, the municipality hopes to generate 100,000 extra jobs with an 'economic offensive', which will limit the number of commuters in the city. Due to the quality improvement of the main bicycle network, the relatively long distances are easier to bridge. In the Mobility Plan, the choice is also made to encourage bicycle use among groups that currently cycle little. With the primary goal of structurally reducing car journeys shorter than about five kilometres. The municipality cooperates with the ANWB, to seduce car commuters with electric scooters and bicycles using the so-called 'Electric Freeways' (Dienst Stedelijke Ontwikkeling Almere, 2013).

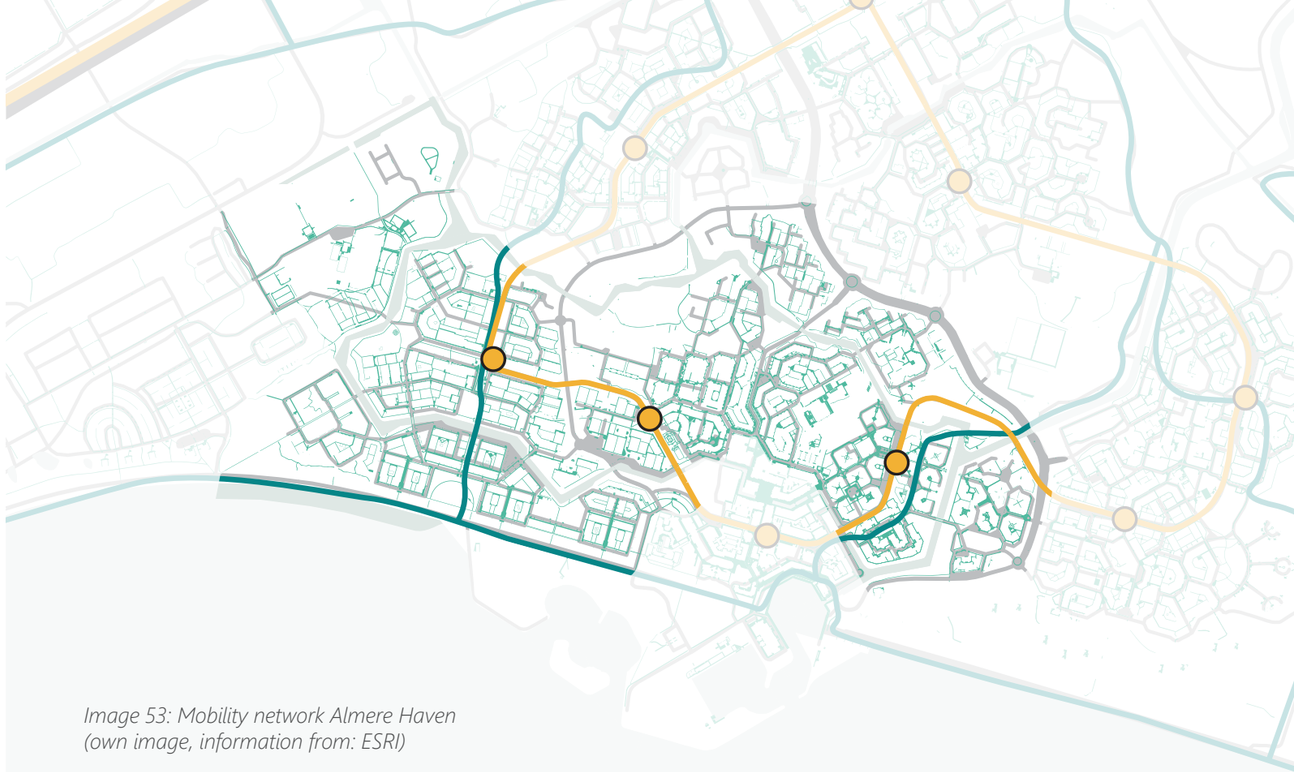


Image 53: Mobility network Almere Haven (own image, information from: ESRI)

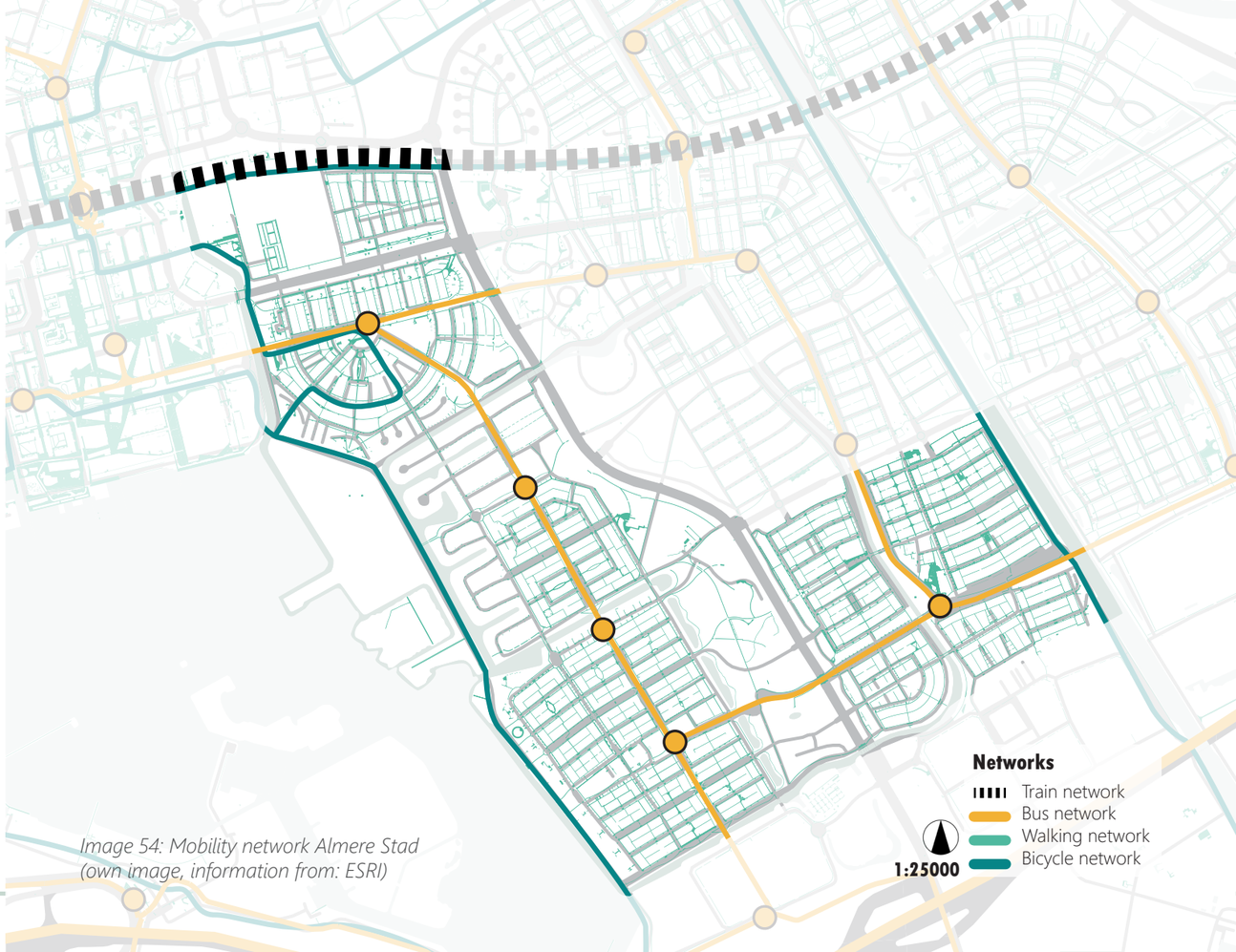


Image 54: Mobility network Almere Stad (own image, information from: ESRI)



Image 55: 1950s future car (Hosansky, 2014)

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METHODS - SCENARIO

Scenario planning

Expectations for the future on how, where and when we act form the base of decisions we make. However, our world is highly unpredictable, and we work only a limited range of expectations. This results often in wrong expectations and therefore wrong decisions. To develop more resilient policies, scenario planning provides a framework to face unpredictable and uncontrollable future uncertainties. A scenario forms an explanation of a plausible future. This involves using contrasting scenarios to explore the uncertain (Peterson et al., 2003).

Initially, scenarios are developed by Herbert Kahn, trying to create accurate forecasts. Based on constructed scenarios he produced a range of forecasts which differed in a few key assumptions. Later, scenario planning was further elaborated at SRI International, a U.S. research institute, and at Shell Oil (Peterson et al., 2003).

Scenario planning is used as systematic method. It allows someone to think creatively about possible futures, which are often complex and uncertain. Key in scenario planning is considering a variety of possibilities including a range of important uncertainties. This is done in a systematic way rather than focussing on an precise prediction of a single outcome. Scenarios can form alternative and dynamic stories, capturing key ingredients of our uncertainty about in this case automated mobility. It gives insight into drivers of change and implications of current processes. This can result in different options for certain actions (Peterson et al., 2003).

A scenario consists of a few different stages. Roughly 6, which are described below.

The first stage is the identification of the focal issue. With a specific question the future can be examined separating the knowable from the unknowable aspects, and the controllable from the uncontrollable. The focal issue of this project is the development of automated mobility and the impact of it on urban health.

The second stage is the assessment stage. This stage the focal issue is used to organise an assessment of the impact on people, institutions, systems, etc. Besides, it is also important to identify external changes which will have an effect on different systems. The first is done by developing an impact assessment, to see and assess the impact of each scenario. The second is done by listing a couple of trends which will have an effect or are affected by some scenario elements.

The thirds stage involves the identification of alternatives. The scenario planner identifies here in which alternatives the system could evolve. Alternatives should be plausible and relevant to the focal issue. In this stage the scenario determinants are defined.

The fourth stage is building the scenario. A set of scenarios can be built upon the knowledge gained from the assessment process and the alternatives definition. The key uncertainties are here leading. Forming a set of different scenarios is valuable, to think about the system in new challenging ways. In this project this is done by setting up a progressive, a conservative scenario and a realistic scenario.

The fifth stage consists of testing scenarios. The scenarios, and especially the dynamics within them should be plausible. Actors, nature, systems should act in a plausible way, this enhances the consistency of the scenarios. Inconsistencies in scenarios are major obstacles in developing policies.

The sixth stage is policy screening. Sets of scenarios can be used to test, analyse and create policies. This can be done by assessing existing policies, and how they will express within different scenarios (Peterson et al., 2003).

In this project a specific scenario constructor is developed. This is done because existing scenario builders (see image 56 and 57) were often limited to only two scenario determinants. In existing scenario constructors for automated mobility, the determinants used are often the level of automation and the degree of sharing. This are important determinants, however for the future with automated mobility there are more important determinants. Therefore, a specific scenario constructor is developed for this project. It focusses on the manifestation of automated mobility in the future, the impact on urban health and therefore activity and mobility patters stand out in the scenario constructor. The scenario constructor is made in a generic way, it can be used for different locations.

In the following paragraph the scenario determinants are described, followed by a paragraph on the trends which affect or are affected by the scenario determinants. In the paragraph scenario constructor, the scenarios are described in a table. The chapter will be closed with a conclusion.

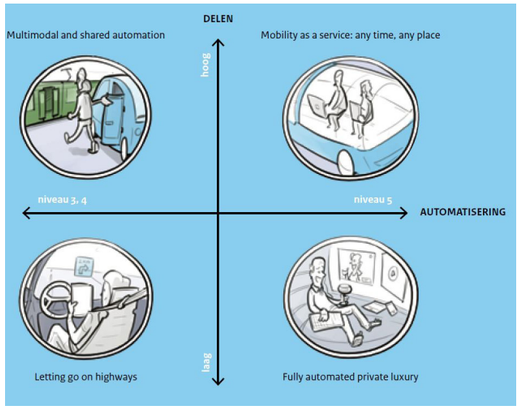


Image 56: Scenarios automated mobility (Kennisinstituut voor mobiliteitsbeleid, 2015)



Image 57: Scenarios automated mobility (Stead et al., 2018)

Scenario determinants

The scenario builder for this project focuses on four main determinants of the scenario. First, the ownership and accessibility of the new automated vehicles. Secondly the governance, which emphasises on how and to what extend the automated mobility is allowed. Thirdly the culture and attitude of the society towards the new technology. And fourthly, the technology of the automated mobility itself. All determinants are divided into sub-determinants which can be set out on a scale bar. In this paragraph all determinants are shortly described. In the scenario builder itself is shown how the determinants manifest in different scenarios.

Ownership and accessibility

Sharing
The extent to which people are going to share vehicles but also rides will have a big influence on the cities and society. If people still care about private ownership, the streets are full of self-driving vehicles from different brands. If people are going to accept vehicle sharing and/or trip sharing, it is conceivable that people will order a vehicle which will pick you up, more often (Arcadis, 2018).

Accessibility
New technology offers all kinds of opportunities to develop a mobility system in which everyone can participate. The sharing of transport also means that it becomes affordable for more people. The self-driving car and the small personal autonomous vehicles offer new forms of mobility for all kinds of groups. Technology can help make travelling easier for elderly or disabled people (Stadsregio Amsterdam, 2016).

Price
It is expected that no major barriers will arise from an economic perspective. Around 2025, the technology will cost € 10k per car (on top of the cost of the car itself). In the 10 years thereafter, the costs decrease due to scale and learning effects to less than € 3k per car. The costs for a self-driving car will be comparable to a current normal car. The extra costs of self-driving technology are eliminated by savings on the insurance premium and lower fuel consumption (The Boston Consulting Group, 2016). When there is a limited acceptance and interest of the consumers, this can lead to less investment in new technologies. This might result in more expensive cars (Kennisinstituut voor Mobiliteitsbeleid, 2015).

Ownership
This determinant is mainly driven by the consumers. On the one hand consumers might believe that the self-driving car a is great invention. So great that they want the car for themselves and their families. On the other hand, consumers might be convinced of the usefulness and sustainability of car sharing. This can be stimulated by the car industry which focuses more on 'mobility as a service' (Kennisinstituut voor Mobiliteitsbeleid, 2015).

Parking
In the scenarios where sharing does not evolve extensively, probably people like to park their private car in front of their door. The parking pressure remains. When the car can drive automatically and will be shared anywhere and anytime, fewer cars are needed to meet the mobility needs. Those cars can be parked outside the city if they are not in use (Kennisinstituut voor Mobiliteitsbeleid, 2015).

Separation of flows
Due to increased traffic complexity, the possibility to abuse the automated vehicles by pedestrians/cyclists and the aim for continuity of the flows, it might be possible that there will be decided to separate the flows when automated vehicles are introduced (The Boston Consulting Group, 2016). Due to separation of flows pedestrians or cyclists are probably not allowed to cross fast traffic lanes everywhere, because that will disrupt the flow. This results in a reduced accessibility of the urban structure for pedestrians or cyclists. (Stead et al., 2018).

Governance

Initiative
The drivers and initiators for development and implementation of automated mobility can be either national or local or everything in between. When locally driven the automated vehicles will only act on testing grounds and will not interfere with the main mobility network. When nationally driven all networks and systems can be optimised to meet the goals in sustainability, safety and liveability.

Goal
The goals for development define how and where autonomous vehicles will act in cities. Planet is one of the main drivers for change. With climate change and resource depletion, new sustainable solutions should be developed. Driven by politics the emphasis is more on people (left orientated parties), or more on profit (right orientated parties).

Allowing AM
Now, if someone's travels with public transport this ride often includes an active mode of travelling towards the stop/station. When automated vehicles are introduces, some people will chose autonomous forms of traveling over active modes of travelling or public transport. Both will lead to less active travels. To promote active travel the access of automated vehicles in the city should be limited (Stead et al., 2018).

Culture & attitude

Attitude towards technology
The attitude and acceptance of new mobility will have a big influence on how and to what extend automated mobility will be adopted by society. On the one hand consumers might embrace it, on the other hand they might decline it.

Safety experience
As above described in the attitude towards technology part, people will embrace or decline the new developments. On the long term, when a new technology is integrated more people will believe in it. People do use new innovations but are still sceptical of safety. When something happens, it takes some time to have trust in that innovation again. See for example the Stints (electric carts) used in children's day-care facilities.

Active travel behaviour
The self-driving car might offer a lot of convenience and comfort. So much that we do not use the bike often and walk less. Only if we specifically decide we need to go by bike for more physical activity, people will do this. It is predicted that 30% of the bikers, 50% of

Level	Name	Narrative definition	Execution of steering and acceleration/ deceleration	Monitoring of driving environment	Fallback performance of *dynamic driving task*	System capability (*driving modes*)	BMSt level	NHTSA level
***Human driver* monitors the driving environment**								
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a	Driver only	0
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes	Assisted	1
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes	Partially automated	2
***Automated driving system* ("system") monitors the driving environment**								
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes	Highly automated	3
4	**High Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes	Fully automated	3/4
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**	-	

Image 58: Levels of automation
(Snelder, van Arem, Hoogendoorn, & van Nes, 2015)

the train users and 70% of the bus users will switch to automated vehicles (The Boston Consulting Group, 2016). An decrease in the use of public transport because automated mobility will be more time efficient, can lead to less active travels towards the public transport stations.

Value of time
When the amount of time that can be spend on other activities than the driving of a vehicle, the value of time decreases. When using self-driving vehicles, the value of time is therefore relatively low. When someone still need to have his hand on the wheel and focus on the road the value of time will increase (Arcadis, 2018).

Technology

Level of automation
The level of automation is categorised into 5 level (see image 58). In levels 1-2, the driver himself keeps an eye on the environment, while the technology takes over from level 3. If the driver is no longer required as a 'back-up' in certain environments, then level 4 is used. With full automation, the car runs fully automatically on all roads and in every situation. The driver has become a passenger and does not have to take over control in any situation (Kennisinstituut voor Mobiliteitsbeleid, 2015). These techniques will be available in a couple of years, the question is whether and how this will be allowed and used.

Where automated
Where automation is allowed has a big impact on the way automated vehicles will act in cities. There might be a scenario where automation is allowed everywhere. However, on the other side, there might be another scenario where automation is only allowed on, for example, highways. In the busy and complicated cities, the driver still needs to drive himself. Compared to now, the driver will receive more support information (Kennisinstituut voor Mobiliteitsbeleid, 2015).

Self-driving manned/unmanned
Also depending on the level of automation and where the automated mobility is allowed vehicles can drive around with or without passengers and/or drivers. If allowed cars can find their way independently. The car will pick you up, and you will be delivered to your destination. Afterwards it drives to a central parking area or is picking up or dropping of someone else. When not allowed more cars will be parked in front of the door (when privately owned), the parking pressure will not decrease (Kennisinstituut voor Mobiliteitsbeleid, 2015).

Communication vehicles
In recent years Dutch policy has focused on improving traffic management and the development of cooperative systems because of the contribution of these systems to government goals such as less reducing congestion and developing safer and more sustainable traffic. However, when there is a limited acceptance and believe in digitalisation of technology this might disrupt the innovation adoption (Snelder, van Arem, Hoogendoorn, & van Nes, 2015).

Scenario trends

The scenario is a subject to trends. Therefore, in this paragraph a few trends are listed which will have an effect or are affected by the scenario determinants. In the scenario builder for each scenario determinant is made visible which trends will have an effect or are affected by the scenario determinant. This will be done by using a colour scheme (see image 59). By applying this scheme on the scenario builder, a three-dimensional scheme arises. The trends are shortly described in this paragraph.

Demographic trends

Population growth

At the social level, there are a number of developments that increase the need for mobility. The population continuously grows due to natural growth, migration and rising life expectancy. The growth of the population leads to more trips to and from the places where people settle. The extra trips are both home-to-work trips as a result of the growing workforce and extra recreational trips due to the growth in the number of pensioners (Hermans, 2017).

Ageing population

Aging of the population is the process whereby the age structure of the population changes and the share of older age groups increases. The average age of the population increases. The increase in average lifespan in the past was mainly due to the reduction of infectious diseases, the gain in life years was then mainly booked at the beginning of life. Nowadays, most health gains are made in the fight against chronic diseases, and especially older people benefit from this. Substantial investments in hygiene, food and health care are the basis of this progress. The life expectancy in 2060 for men is almost 87 years and 90 years for women (Ekamper & van Nimwegen, 2018).

Economic trends

Economical growth

The global economy is expected to continue to grow. Economic growth can lead to more employment and rising prosperity. Employment is concentrated in the cities. This means that home-work and work-work trips are also more focused in the cities. Traffic between cities will increase, both by home-work traffic, work-work traffic and by transport. The rising prosperity also causes a growth of the leisure economy. It is easier to visit the Netherlands from other parts of the world. By improving the accessibility of living, working and recreation, and the increased diversity of the population and further individualization of society, there is an increased flexibilization in both the living and working location choice (Hermans, 2017).

Flexible working

Flexible working includes new or other work locations and working schedule, which differs for the employees from day to day. Thanks to the new way of working, employees get, where this is possible, more and more responsibility in determining the work location. This makes movements more diffuse and the need for demand-driven transport grows (Hermans, 2017).

Global trends

Urbanisation

The process of urbanization refers to a shift in population living in rural areas to urban areas. More and more people live in urban areas (Wikipedia, 2018g). Nowadays, globally more people live in urban areas than in rural areas. And, it is projected that 66% of the world's population lives in urban areas by 2050 (United Nations, 2015).

Globalisation/internationalisation

Globalisation refers to an ongoing process that is links many scales, from neighbourhoods to countries, more closely together. People all over the world are intertwined. Boundaries are becoming less relevant, which makes the world, figuratively, smaller. Globalisation is mainly driven financial flows and trade, in the economic sector. Within the technological sector it is steered by information technology and mass media. It is also driven by human flows, like migration, exchanges tourism (UNESCO, 2010).

Climate change

Throughout history the climate on earth is changing. The current warming trend, most likely the result of human activities, is of particular significance because it is proceeding at a rate that is unprecedented over decades to millennia. This global climate change has a big impact on the environment. It is leading to glaciers which keep shrinking, animal and plant ranges which are shifted, and the ice on rivers is breaking up earlier. The climate change is mainly caused by greenhouse gasses produced by human activity. If nothing changes the global temperature will continue to rise for the coming years (NASA, nd.).

Social trends

Individualisation

Individualisation is the process in which people stand more as individual instead of as a group in the society. This process has started with industrialisation. Industrial developments in the 20th century have led to an increase in prosperity. This, together with the democratization movement in the 1960s, certain groups became more independent in society. Workers received more rights and women were no longer dependent on their husbands. At the same time, the technological developments of the mass media gave people from a certain ideological group the insight that they could look beyond their group boundaries. This process is known as 'de-pillarization' (Dutch=ontzuiling). Today, the Western world is seen as an individualized world (Wikipedia, 2018d).

Social segregation

Social segregation is the socialization process of acculturation where members of a non-dominant group are forced to barely interfere with the dominant group. They mainly have only contact with the other members of their own group. Segregation often manifests in, for example, living in the same neighbourhoods as other people of the segregated cultural group, speaking their own mother language, sticking with their own religion, etc. With the rich it is often about separating the environment motivated by safety considerations. The most characteristic example of this is the gated community (Wikipedia, 2018e).

Technological trends

Digitalisation

The process of digitalization refers to the ongoing use of digital technologies. Technologies are used in many different activities, human and social. For example, this includes the digitalisation of health care, government, businesses and the costumer (i-scoop, 2016).

From ownership to usage – sharing economy

Sharing economy refers to a socio-economic system in which sharing and collective consumption take a central place. Within the sharing economy there is a joint production

and consumption of goods and services. Information technology is often the catalyst that provides information to individuals, non-profit organizations and governments that enable the sharing and reuse of overcapacity. Product-service systems are business models that provide for a collaborative use of goods and services (Wikipedia, 2018c).

Automated mobility
Automated mobility refers to self-driving car/ vehicles. Aiming for sustainability, traffic safety and improving traffic flows the development of automated mobility is one of the figureheads of innovation. Besides tackling some economical goals, automated mobility might give the possibility to tackle social and urban goals, like including all kinds of groups and releasing the pressure in the city. Since the scenario is focusing on the future of automated mobility the trend of automated mobility is applied to all scenario determinants.

Climate trends
Sustainable development
According to the definition of Brundtland sustainable development can be described as the following: "Sustainable development is development that meets the need for the present without compromising the ability of future generations to meet their own needs". Considering climate change, environmental degradation, overconsumption, population growth it is necessary to find sustainable solutions to achieve environmental sustainability (Wikipedia, 2018f).

Health trends
Non-communicable diseases – unhealthy lifestyles
Non-communicable diseases affect people all over the world. People associate non-communicable diseases often with older people. However, 15 million of all deaths attributed to non-communicable diseases take place in the age group between 30 and 69 years. Unhealthy diets and lifestyles, exposure to tobacco smoke or the excessive use of alcohol, are all risk factors contributing to non-communicable diseases. That's why not only elderly or children, but also lots of adults are vulnerable groups in getting non-communicable diseases (WHO, 2018).

Elderly longer at home
The government in the Netherlands stimulates that elderly live longer at home independently. If elderly stay healthy, they can continue living independently with relatively little care. But if they have health problems, adapted homes or extra care may be necessary (Rijksoverheid, nd.). The government does this because over the coming decades, the number of elderly people will grow spectacularly. In addition, nursing homes already suffer from staff shortages (Jansen, 2017).

Improved health care
Nowadays, most health gains are made in the fight against chronic diseases, and especially older people benefit more from this. Substantial investments in hygiene, food and health care are the basis of this progress (Ekamper & van Nimwegen, 2018). On top of this, more and more research is done and treatments are developed which can cure sick people.

Trends	Color code
Demographic	
Population growth	
Ageing population	
Economic	
Economical growth	
Flexible working	
Global	
Urbanisation	
Globalisation/ internationalisation	
Climate change	
Social	
Individualisation	
Segregation	
Technological	
Digitalisation	
From ownership to useage	
Automated mobility	
Climate	
Sustainable development	
Health	
Non-communical diseases - unhealthy lifestyles	
Elderly longer at home	
Improving health care	

Image 59: Trends scenario (own image)

Scenario constructor

In this paragraph the scenario builder is shown. In the first column the scenario determinants are listed. In the slider is shown how a progressive scenario will manifest and how a conservative scenario will manifest. According to the people, the market and the government the determinants will be manifested in cities and societies differently. The description of the conservative scenario, the realistic scenario, and the progressive scenario is shown the second, third, and fourth column. In the third column is the realistic scenario described, a scenario in between the progressive and conservative. The scenarios will follow each other in time. During the first transition phase towards AM the conservative scenario will be leading, afterwards the realistic scenario will be leading. Finally, when AM is fully embraced and implemented the progressive scenario will be leading. In the fifth column is made visible what impact (spatial) the determinants might give. The scenarios are overlaid with the trends, see colour code. In the last column a classification is made to show which determinants are most decisive, most driven by sustainability arguments, most driven by the opinion of the community, and which determinants can influence health the most.

Legend

- Progressive scenario
- Realistic scenario
- Conservative scenario
- Main determinant
- Health deterimant
- Sustainability determinant
- Opinion deterimant

Scenario determinants	Conservative development	Realistic development	Progressive development	Image [conservative vs. progressive]	Symbol
Ownership & accessibility					
Sharing Low — High	Consumers believe that the self-driving car is a great invention. So great that they want the car for themselves and their families. Of course, some are willing to share their car with others, but they form the minority (KiM, 2015).	Both shared vehicles and owned vehicles will be driving around. Mobility as a service becomes more popular and cheaper, thats why more people are going to use this. Still some people will own a private vehicle, mainly as status symbol.	Some people still own a car as status symbol. But more and more people choose to share a car. After all, it saves costs and, not unimportantly, the quality of life in cities improves considerably. Sharing contributes to a sustainable environment and for that reason not only cars but also many rides are shared (KiM, 2015).	**Road capacity - car dominance** *- more cars on the roads* VS *+ less cars on the rooads*	▲ ●
Accessibility For elite — For everyone	Situation stays more or less the same as now. People do need a drivers licence to drive automated vehicles. Driving in these vehicles is ownly accessible for people who are able to, and are allowed to get a driversli-cence.	Because most of the vehicles still need a driver, the situations stays more or less the same as it is now. It is only accessble for people who own a licence (KiM, 2015).	The self-driving car has attracted new groups of travelers. People with disabilities, such as the blind or visually impaired, and children and the elderly who are not able or are not allowed to drive a car, can now be transported by self-driving cars (KiM, 2015).	**Accesibible for..** *only for the elite* VS *including new groups*	

Scenario determinants	Conservative development	Realistic development	Progressive development	Image [conservative vs. progressive]	Symbol
Price AV *Cheap* — *Expensive*	The limited acceptance and interest of consumers has led to that the car industry has invested with some restraint in automation and in the further technical development. Result: automated vehicles will be more expensive (KiM, 2015).	The price of the automated vehicles will still be quit high. However, cheaper alternatives (including e.g. vehicles which are shared. Mobility as a service, with a shared system, will in the end be cheaper than a car now.	The costs for a self-driving car are comparable to a current normal car. The extra costs of self-driving technology are eliminated by the savings on the insurance premium and lower fuel consumption (The Boston Consulting Group, 2016).	**Price** € > €€ vs € = € *automated vehicles more expensive then 'old' cars (for some affordable)* *price more or less the same as 'old' cars (for everyone affordable)*	
Ownership *Private* — *Public*	Consumers believe that the self-driving car is a great invention. So great that they want the car for themselves and their families. The self-driving car is equipped with all kinds of gadgets and fully tailored to the wishes of the owner. The car is still parked in front of the door and is still a status symbol (KiM, 2015).	Both publicly owned (mobility as a service) and privately owned vehicles will be driving around. Mobility as a service becomes more popular. More vehicles will be publicly owned.	Motorists are convinced of the usefulness of car sharing. This fits in a broader development: the sharing economy is flourishing. It is now the natural thing in the world to share things and services with others. The car industry no longer aims to sell as many cars as possible, but focus on mobility as a service (KiM, 2015).	**Ownership** *private - owned vehicles* vs *public - mobility as a service*	▲ ●
Parking *In front of the door* — *Central place*	The car is still parked in front of the door. There are no big parking places outside the city, since the cars still need a driver in the city and can not drive automatically in front of the door. Whoever has a (shared) car keeps it, forced, nearby. Parking in cities remains a problem because everyone still wants to have a car. Even a digital parking assistant that helps to find an empty spot quickly does not help enough. Cars dominate cities (KiM, 2015).	Cars can now find their way independently, but are not allowed to drive around without a driver. Whoever has a (shared) car keeps it, forced, nearby. Publicly own vehicles will be parked at a central location (KiM, 2015).	Cars are intensively used and they mainly drive around. If they do not drive (for example at night) they are parked on the street and especially on parking lots on the outskirts of the city or village. In this way, a lot of space will be released in the city (KiM, 2015).	**Parking** *in front of house* vs *at a central point* (hub)	▲ ★
Seperation of flows *Shared roads* — *Seperation of flows*	The flows will be partly separated. This will be done in more or less the same way it is already done (The Boston Consulting Group, 2016).	There are streets where the flows are separated to promote safe, efficient and sustainable mobility. There are also shared streets (only slow traffic).	Due to increased traffic complexity, the possibility to abuse the automated vehicles by pedestrians/cyclists and the continuity of the flows, the flows will be separated. In this way the traffic complexity is reduced and the traffic can flow (The Boston Consulting Group, 2016).	**Flows on road** *shared* vs *seperated*	★

Scenario determinants	Conservative development	Realistic development	Progressive development	Image [conservative vs. progressive]	Symbol
Technology					
Level of automation *Low (level 0) — High (level 5)*	In levels 1-2, the driver himself keeps an eye on the environment, while the technology takes over from level 3. If the driver is no longer required as a 'back-up' in certain environments, then level 4 is used (KiM, 2015).	There si full automation on highways. The car runs fully autonomous on these roads and in every situation. On othere roads the driver still need to keep an eye on the street. People will be driving in level 1-3 (KiM, 2015).	With full automation, the car runs fully autonomous on all roads and in every situation. The driver has become a passenger and does not have to take over control in any situation (that is not even possible) (KiM, 2015).	**Level of automation** *Hands on the wheel* vs *Hands off - doing whatever you want*	▲
Where automation *Only certain roads — Everywhere*	Some cars achieve high degree of automation. The driver can lean back and release the steering wheel, on highways. But other cars all still not capable of doing this (KiM, 2015).	On the motorways, facilitated by the government, a relatively high degree of automation has been achieved. There the driver can lean back and release the steering wheel. In the busy cities drivers have to drive here, but receive all kinds of supporting information (KiM, 2015).	Cars can now find their way independently. The car will pick you up, and you will be delivered to your destination. Policy and rules have been adjusted so that the self-driving vehicle is given ample room (KiM, 2015).	**Where automation** *Only on highways* vs *On and of highways*	▲
Self-driving manned/unmanned *Manned — Unmanned*	The cars are still parked just in front of the door. There are no big parking places outside the city, since the car still needs a driver in the city and can not drive automatically in front of the door. Whoever has a (shared) car keeps it, forced, nearby (KiM, 2015).	Cars can now find their way independently, but are not allowed to drive around without a driver. Whoever has a (shared) car keeps it, forced, nearby (KiM, 2015).	Cars can now find their way independently. The car will pick you up, and you will be delivered to your destination. Afterwards it drives to a central parking area or is picking up or dropping of someone else (KiM, 2015).	**Unmanned/manned** *Driving around manned always* vs *Driving around unmanned*	▲ ★
Communication vehicles *Autonomous — Cooperative*	Regarding privacy and safety not all vehicles are communicating cooperative. People are afraid that the newly developed and safely assumed systems could be hacked. Although, due to technical improvements these risks eventually became very small and the confidence in technology increased, this certainly does not apply to all people (KiM, 2015).	Dutch policy focuses on improving traffic management and the development of cooperative systems because of the favorable contribution of these systems to government targets such as less congestion, safer and more sustainable traffic. This will be more and more common (Snelder et al., 2015).	In recent years Dutch policy has focused on improving traffic management and the development of cooperative systems because of the favorable contribution of these systems to government targets such as less congestion, safer and more sustainable traffic. The development track to automated cars that do not communicate is seen as a disruptive innovation (Snelder et al., 2015).	**Communication** *No communication - distance between vehicles is bigger* vs *Communication - distance between vehicles is small*	▲

Scenario determinants	Conservative development	Realistic development	Progressive development	Image [conservative vs. progressive]	Symbol
Culture & attitude					
Attitude towards technology *Decline* — *Embrace*	The limited acceptance and interest of consumers has led to that the car industry has invested with some restraint in automation and in the further technical development (KiM, 2015).	On the short term the opion of the public is scattered. On the longer term it is more intergrated in our cities and societies. It becomes normal.	Consumers believe that the self-driving car is a great invention. The consumer has confidence in the new technology (KiM, 2015).	**Car fleet** *dominated by 'old' cars* VS *dominated by automated vehicles*	
Safety experience *Sceptical* — *Naive*	Many people were not enthusiastic about the self-driving car. They think it a creepy idea to surrender to technology. Is the technology 100% reliable? (KiM, 2015).	Digitalisation of the society. People are aware of what they share. However still people like the new innovations and increased comfort and ease. Untill something goes wrong...	The automated vehicles are protected against hackers. Consumers trust in the system and have confidence in the new technology. Perhaps this is to naive, might AM be still hackable? (KiM, 2015).	**Safety experience** *sceptical* VS *naive*	
Travel behaviour *Not active* — *Active*	The self-driving car has little impact on active travel behavirour. The role of the bicycle has hardly changed. The car still has plenty of space within the city (KiM, 2015).	The introduction of the self-driving car offers a lot of convenience and comfort. More and more people will choose AM over active forms of travelling. In the end 30% of the bikers, 50% of the train users and 70% of the bus users will switch to automated vehicles (The Boston Consulting Group, 2016).	The self-driving car offers a lot of convenience and comfort. So much that we do not use the bike often and walk less. After all, we can sit dry in the automated car and we have everything at hand. It is a rolling second home for both inside and outside the city. Within the city the self-driving car gets plenty of space (KiM, 2015).	**Active travel behaviour** *take the bike whenever possible* VS *ease and comfort in AV*	
Value of time *High* — *Low*	When amount of time in a car can only to be spend on driving, the more the value of time increases. When this time is extended due to traffic jams the value of time increases even more (Provincie Noord-Holland, 2018).	Time = money: value of time stays high eventhough we can do other stuff in our vehicles now. We want to be at our place of destination, however it is not that worse if it takes you a few minutes longer.	When the amount of time that can be spend on other activities than the driving of a vehicle, the value of time decreases. When using self-driving vehicles the Value of Time is therefore relatively low (Provincie Noord-Holland, 2018).	**Value of time** *high - driving during traffic jam* VS *low - can do everything during traffic jam*	

Scenario determinants	Conservative development	Realistic development	Progressive development	Image [conservative vs. progressive]	Symbol
Governance **Initiative** *Local* — *National*	New technologies are only used and tested in small testing hubs. All the different initiatives are not coordinated.	Driven by regions like the AMA region who wants to be frontrunner and play an exemplary role for the rest of the world. The AMA sees smart mobility as solution to help move people and goods faster, cleaner and easier through the increasingly busier AMA (Metropool Regio Amsterdam, 2017).	National government is main driver for technological development. With the main goals of sustainability and traffic safety they invest and promote new ways of smart mobility.	**Initiative** *Local- no connections with the rest of the city* VS *National - good connections between the rest of the cities*	●
Goal *Profit* *Planet* *People*	Households want their own car. The car industry is doing well, but the competition is tough. New market actors, such as Google and Apple, also entered the car market. In order to stay ahead of the competition, car manufacturers are committed to developing all kinds of models. Among these, there are also luxury status symbols. Much money is earned here (KiM, 2015).	Planet and profit are the main drivers for change. With climate change and resource depletion there should come new sustainable solutions. Driven by politics the emphasis is more on climate (left orientated parties). However, New market actors, such as Google and Apple, want to profit from the new developments as well.	The self-driving car cannot come anywhere. The city is divided into zones and those who want to enter the center have to pay more for it. The city has to stay green and residential cities which are cyclable and walkable are preferred. The government considers AM as favorable development from the point of view of sustainability and traffic safety (KiM, 2015)	**Goal/motivation** VS *Planet & Profit* *People & Planet*	●
Allowing AM *Limited access* — *Unlimited access*	The self-driving car can come almost everywhere. However, it is not everywhere allowed to drive fully automated.	The self-driving car can come almost everywhere. They drive fully automated on highways. In more and more streets the car is guest, or is not allowed anymore.	The self-driving car cannot come anywhere. The city is divided into zones and those who want to enter the center have to pay more for it. The city has to stay green and residential cities which are cyclable and walkable are preferred (KiM, 2015).	**Allowing** VS *Unlimited access* *Limited access*	★

Image 60: Scenario builder (own image)

Conclusion

In the previous paragraph the scenario constructor with the scenarios, trends, icons and symbols are shown. There are three main scenarios: the conservative scenario, the realistic scenario, and the progressive scenario. The progressive scenario will be used to design for the two neighbourhoods. With information gained from this design can be said which steps already have to be made in earlier scenarios.

In the last column of the scenario constructor a classification has been made to show which determinants play which role. This shows that the determinants Parking, Self-driving manned/unmanned, Travel behaviour, and Allowing AM will influence urban health the most. Urban health will be mainly influenced by the ease, convenience and comfort the new mobility will provide, and how the public will use it. 30% of the bikers, 50% of the train users and 70% of the bus users will probably switch to automated vehicles (The Boston Consulting Group, 2016). Nowadays, travelling with public transport involves often an active mode of transport. However, now public transport is not the only mode with the advantage of doing something else while travelling anymore. More and more people will switch to using automated vehicles.

The most decisive determinants are the technological determinants, the determinants considering sharing and ownership, parking and travel behaviour. Technological determinants influence on the one hand which technology is available and ready to use. On the other hand, it influences to what extend and where automated vehicles are allowed. This has a big impact the mobility patterns on the future. The sharing determinant is one of the other decisive determinants. It will influence to a large extend how many cars will be driving around, this might influence the space for active modes for transport in the streets. The parking determinant is linked with the Self-driving manned/unmanned determinant. If vehicles are allowed to drive around unmanned this might result in less vehicles in the streets because they can park somewhere else, however it also results in more (lost) vehicle kilometres. If the unmanned vehicles are not allowed this might result in more and more cars in the streets because automated mobility is available for a bigger group of people.

There are also some determinants which are marked with a circle as symbol. These determinants are mainly driven by sustainability considerations. When choices, by governance and public, are more sustainability driven these determinants can play a big role in achieve sustainability goals.

Besides, the scenario builder made visible for each scenario determinant which trends will have an effect the scenario determinant. For the theme of ownership and accessibility are many trends highlighted. This means that many determinants are subject to many areas different of trends. The determinants will be influenced by trends a many levels and at different moments in time. This can happen both in favour of or against the development of the determinant in time.

For the theme technology the trends which will be mainly affect the determinants are economical trends, technological trends and global trends. The economical and technological trends will contribute to enabling the technological development of the automated mobility. Global trends will influence the development of the technology by a certain need for change to improve liveability and global climate.

The theme of culture & attitude is mainly influenced by the social and health trends. The introduction of automated mobility might improve trends on the social level by the accessibility of mobility for a bigger group. Health trends will effect the development of the automated mobility which can result in both positive and negative health outcomes. For example, an increased mobility use for a bigger group of people (more elderly) due to comfort and ease, will have an effect on the activity patterns of people.

For the theme governance counts that the trends in economy, climate and global changes will affect the determinants the most. These trends are most of the time drivers for change.

In the impact assessment of image 61 is the impact of each scenario on different systems represented by a [+] (positive impact), [-] (negative impact) or [o] (neutral impact). When looked at the progressive one, it becomes clear that this scenario might have quite a positive impact on a number of systems which are listed. On top of this, with the introduction of automated mobility the air and noise pollution will be reduced and safety will be improved. All improving the urban health. However, this scenario will probably have a negative impact on the communities' activity patterns. Due to the ease and convenience more people will choose automated mobility over active modes of travelling. So the progressive scenario will influence urban health in a positive and negative way. The design later on will aim for designing with automated mobility as catalyst for health. Meaning that the determinants that are negatively influencing urban health should be translated into positive determinants.

Within the other scenarios the impact on urban health is also partly positive but mainly negative. Due to increased traffic complexity (due to all those different modes of traveling) the accessibility for cyclists and pedestrians will be reduced.

Impact determinants	C	R	P
Accessible city			
Space for pedestrian/cyclist	-	-	+
Flow in & out city	-	-	+
Connections in & out city	-	+	+
Transport of goods	o	+	+
Public transport	o	o	-
Attractive city			
Quality public space	-	-	o
Image of the city	-	o	+
Sustainable city			
Reduce energy consumption and production	-	o	+
Stimulating cirular economy	o	o	-
Economical city			
Increase prosperity inhabitants	o	o	+
Strengthening competitive position	o	o	+
Healthy city			
Improving health (activity)	o	-	-
Improve air quality	+	+	+
Reduce noise production	o	+	+
Social city			
More inhabitants have a job	o	o	-
More inhabitants are independent	o	o	+
Less people financial impediment	o	o	o
Social inclusiveness	o	o	+
Urban development			
More living and working spaces	o	o	+
More people live in the city	+	+	o
More people live outside the city	-	o	+
Mobility development			
Roadcapacity	-	-	+
Size car traffic/fleet	+	+	-
Vehicle kilometres	+	+	+
Vehicle loss hours	+	o	-
Traffic complexity	+	+	o

Image 61: Impact assessment (own image)



Image 62: High line park (Ciararh, n.d.)

Urban health **136**
Improving urban health **140**
Designing urban health **146**
Design interventions **149**

URBAN HEALTH

Urban health

Urban health
In 1949 the World Health Organisation (WHO) developed the following definition of health:

''Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being, without distinction of race, religion, political belief, economic or social condition" (Barton & Tsourou, 2000, p. 7).

Now, globally more people live in urban than in rural areas. And, it is projected that over 66% of the world's population lives in urban areas by 2050. Good planning and governance will allow economic and social development in these urban areas. However, sustainable development is threatened when this growth pursues rapidly and unplanned (United Nations, 2015). The trends in urbanization have significant effects on living conditions and the environment (United Nations, n.d.). The quality of the environment and nature of development have a big influence on health (Barton & Tsourou, 2000). Although living in cities brings individuals and families great opportunities, also some health risks might emerge due to urbanisation. These risks vary per city and local context. These health risks and social challenges include infectious diseases which can be worsened by poor living conditions. It also includes non-communicable diseases like diabetes, heart diseases, obesity, and some cancers, mainly caused by unhealthy diets and lifestyles. Besides it includes accidents, injuries, violence and crime (World Health Organisation, 2010).

To accommodate healthy and the well-being for the whole population, improving health will remain a global priority. It contributes to realising human potential and helps to create economically vibrant, equitable and inclusive cities (World Health Organisation, 2016). There are, according to the World Health Organisation (2010) a few actions needed to realise a healthy urban environments. Firstly, they advocate that urban planning for healthy lives and safety needs to be promoted. Secondly, urban living conditions needs to be improved. Besides, a participatory urban governance needs to be ensured. Fourthly, cities need to be built inclusive and accessible. Finally, the urban areas have to be resilient to emergencies and disasters (World Health Organisation, 2010).

The healthy neighbourhood constitutes, according to Macintyre, Ellaway, and Cummins (2002), the following features: the availability of a healthy living, working and playing environment, services that provide support to people in their daily lifes. This includes for example education, transport and welfare services. Besides, the reputation of an area and good social-cultural balance constitutes health in neighbourhoods. This includes an inclusive neighbourhood regarding political belief, economic status, religion and ethnicity (Macintyre et al., 2002).

Although, many times is listed what a healthy city or neighbourhood should constitute. There is still a need for study on the features/ elements needed in social and physical environments which promote urban health. There should be an increased focus on the effect of the place on urban health (Macintyre et al., 2002).

Planning urban health - disconnect fields
Within a multi- and interdisciplinary field, urban planning is a profession in which planners strive to improve the welfare of individuals (Kochtitzky et al., 2006). Concerning the interaction between communities and environments (Boarnet & Takahashi, 2005), urban planners contribute to creating more attractive, convenient, equitable and healthful places (Kochtitzky et al., 2006). This is done by influencing social, economic and physical environment and how cities function. There is a wide range of different sectors and tasks in urban planning. What they have in common is the mission to find solutions to community problems (Boarnet & Takahashi, 2005). Within the field of urban planning knowledge of social sciences and urban design are combined. Different processes in cities, like economic, political and social processes, have to be taken into account to create convenient physical compositions. These compositions include the planning of transportation systems, land use development, housing, public open spaces, and so on. These compositions are important determinants of health (Northridge & Sclar, 2003). In fact, the fields of urban planning and urban health have common perspectives and aims. Improving human well-being, emphasizing needs and managing social systems, focusing on the needs of vulnerable populations are shared missions of the both fields. However, both the urban planning as the public health fields have broadened their approaches, tools and perspectives. Where the public health field is more focused on biomedical models, the field of urban planning relies more on geographical models (Kochtitzky et al., 2006). Although the fields expanded their perspectives, for most of their histories they have been interconnected (Kochtitzky et al., 2006).

Despite the fields of urban planning and urban design share common roots, the fields were largely disconnected over the last decades (Corburn, 2004; Frank & Engelke, 2001). The both disciplines went their separate ways (Corburn, 2004; Hoehner et al., 2003). The field of public health focused primarily on laboratory investigations of microbes and the health risk factors caused by individual choices (Corburn, 2004; Macintyre et al., 2002). The host of the disease was investigated, rather than the environment, because this was harder to control for health professionals, the physicians (Corburn, 2004). The urban planning field at the same time started to emphasise on economic development, residential segregation due to suburban development took place (Corburn, 2004). This has led to a bigger reliance on the car for daily use. This in turn resulted in lower physical activity levels, leading to a number of health issues (Badland & Schofield, 2005).

Reconnection fields
After years of disconnection of the two fields, urban planning and urban health, have begun to reintegrate since last two decades (Hoehner et al., 2003; Kochtitzky et al., 2006). Within the field of urban health subjects like physical inactivity, obesity, and other lifestyle related chronic diseases became more pressing. Within the field of urban planning there were growing concerns about environmental impacts of the use of the car. This resulted in shared concerns regarding -among other things- air quality, physical inactivity, parks and green in the cities and injuries in traffic (Hoehner et al., 2003; Kochtitzky et al., 2006).

Planning urban health
The common assumption is that health policies are only a concern for health care professionals, however WHO's definition of

the concept of health (1949) challenges this idea. Health does not only play a central role in the health care profession, it should also play a central role in many more professions. To promote a healthy environment, urban planners play a very important role (Barton & Tsourou, 2000).

However, still many urban planners do not include health issues in the main systems. Yet, major determinants of health are the quality of the environment and the way of development, on which urban planners have a significant influence. On top of that is health an important driver for economic productivity. Health is shaped by household decisions and lifestyles, choices in these are influenced by social and economic opportunities, education, income and the quality of the environment (Barton & Tsourou, 2000).

The model in image 63 shows the factors which influence health. There are four levels of influence. The centre of the models shows the individuals with their predetermined genetic heritage. The centre of the model is surrounded by the levels of influences which can be modified. The first level includes the individual's lifestyle and behaviour. These can be positively or negatively influenced by friendship and community regulations. The second level concerns the social and community influences. The availability or lack of mutual support can have positive or negative consequences. The third level includes structural factors like housing and working conditions and environments. This includes the accessibility to services and facilities. The fourth level incorporates that will influence the society as a whole. This concerns socioeconomic, environmental and cultural conditions (Barton & Tsourou, 2000).



Image 63: Determinants of health (Barton & Tsourou, 2000)

The effects of urban planning on health

The table of image 64 shows the relationship between planning policy areas and determinants of health.

The health determinants are organized by the levels of the model of image 63. How urban planning will affect those is described below:

- Individual behaviour and lifestyle

Healthy lifestyles can be facilitated by the physical environment. This physical environment is shaped by planning decisions. The tendency to walk, cycle or play in the open urban space will be influenced by the safety, quality and convenience of the open space. Regular and moderate forms of exercise can protect an individual against heart diseases, limit obesity and reduce the onset of diabetes. Besides it promotes well-being and can protect elderly form lonelines and depression (Barton & Tsourou, 2000).

- Social and community influences

Urban planning can destroy or cultivate opportunities for a community life. These networks can be formed or affected by the existence of common activities and meeting places. The facilitation of these activities and places is often determined in long-term strategies for housing, transport and economic development. However, planning cannot create communities, it can only affect the opportunities. Without a sense of community, it is likely that people experience less well-being, can get depressed and have higher levels of disabilities form chronic diseases (Barton & Tsourou, 2000).

- Local structural conditions

Planning policies of local structural conditions can affect personal health in a number of ways. For example, the accessibility of work opportunities can mitigate poverty and depression. Consequently, unemployment can result in poor health. Besides, insufficient housing conditions can lead to stress, which will affect health. Social exclusion can be reduced when there is an accessible urban structure and an affordable transport system available. This gives poor and less mobile people the same opportunities as others (Barton & Tsourou, 2000).

- General socioeconomic, cultural and environmental conditions

Urban planning affects at the broadest level of influence, the quality of water, air and soil. It can also mitigate health risks caused by rapid climate change, by reducing the emission of greenhouse gases (Barton & Tsourou, 2000).

The table shows that almost all planning policies can influence several health determinants. A lot of the health determinants are strongly influenced by transport. Showing that it is useful to look into the new forms of transport (AM) in relation with health, to find opportunities. Planning and health are not related in a linear way. To improve health a wide range of actions are needed within the planning policy domain (Barton & Tsourou, 2000).

Determinants of health	Building regulations	Housing policy	Economic development	Social services and benefits	Open space	Transport	Energy, water and drainage	Urban form	Urban regeneration
	Planning policy areas								
1. Personal lifestyles		*	*	*	**	**		*	*
2. Social cohesion		*	*	*	*	*		**	*
3. Housing	**	**					**	*	*
3. Work	*		**			*		*	*
3. Access		**	*	**	*	**		**	*
3. Food		*			*			*	
3. Safety	*	*				**		*	*
3. Equity	*	**	*	**	*	**	*	**	*
4. Air quality	*	*	**		*	**	*	*	*
4. Water and sanitation	**		*		*		**		
4. Soil and solid waste	*		*		*				**
4. Global climated	**	*	**	*	*	**	**	**	*

Image 64: Matrix planning policy and determinants of health (Barton & Tsourou, 2000)

Improving urban health

The table in image 64 shows that different planning policy aspects can influence health on different levels. To improve an aspect of health multiple actions in the planning policy field are required. In this paragraph are the health determinants mentioned, with their health benefits as a result of certain planning policies (Barton & Tsourou, 2000).

Healthy lifestyles
Healthy lifestyles can result in a decreased chance of getting non-communicable diseases like heart disease, obesity, diabetes, depressions or other diseases related to stressful and sedentary lifestyles. Healthy lifestyles will improve both mental and physical health. To stimulate people to walk or cycle to their work, school, shops, etc. planning can create safe, attractive and convenient environments. Recreational opportunities, equally distributed, and the accessibility of locations can be established by development plans (Barton & Tsourou, 2000).

Social cohesion
Social cohesion, constituted by friendships and supportive networks in a community, can result in a fulfilment of someone's life. Chronic illness and depression can be reduced by social cohesion in a community. Besides, it helps people to speed recovery processes after illness. When a social structure is fragmented this leads often to isolation and insecurity. Urban planning might not be able to create local communities, however, it can facilitate it. This can be done by creating safe and accessible environments where people can meet informally. To enlarge social options, mixed-used developments can help. Social cohesion can be undermined by barriers to pedestrian connectivity, insensitive housing redevelopment and dispersal of resident communities (Barton & Tsourou, 2000).

Housing quality
Since the beginning of the profession of urban planning, it was recognised that a lack of hygiene and sanitation in the urban environment caused illness. Therefore, it is of importance that people have access to sufficient housing, mainly for vulnerable groups like elderly and children. Housing quality can be ensured by detailed designs and appropriated energy-efficient materials. Good basis services need to be provided. The housing quality is in danger when, insufficient, overcrowded and unsafe building structures are being made. Choosing a poor location can lead to incidents of crime and vandalism, while overcrowding is related with mental and physical disorders and accidents (Barton & Tsourou, 2000).

Access to work
The accessibility and security to a suitable job increases an individuals' health and well-being. When people are unemployed, they often suffer an increased risk of (financial) stress. This can lead to mental problems and ill health. To facilitate attractive opportunities for business, local job opportunities and diversity in employment urban planning can, by means of economic regeneration, help. By providing local job opportunities trip lengths are decreased. People can more easily take the bike or go to work by walking (Barton & Tsourou, 2000).

Accessibility
By reducing car dependency physical exercise can be stimulated. High physical activity rates can reduce the chance in getting chronic diseases. Children are often dropped off at school by their parents and due to this they miss out on regular exercise. Patterns of physical activity of someone's life is established in their childhood. Urban planning can contribute to making local facilities more accessible. If facilities and services are more accessible people are more inclined to use an active from of travelling. Also, planning policies can manage traffic. By slowing down traffic, cycling and walking networks will be more accessible (Barton & Tsourou, 2000).

Local, low input food production
Inequality in health is caused by social gradients in quality and sources of nutrients. Eating healthy, with fresh fruit and vegetables and less consumption of fats and sugar, promotes someone's health and well-being. However, people who have a low income do not always have the accessibility to healthy food. Introducing local food production can promote mental health and stimulates physical activity. Besides, it gives more people the possibility to eat healthy. Urban planning can assist in providing local food resources. These can be provided by city farms, allotment and market gardens. Planning can also help in encouraging more diversity in local shopping facilities, in this way people are not dependent on their car for going to large supermarkets outside town centres (Barton & Tsourou, 2000).

Safety
Road traffic is the biggest cause of accidents. Especially vulnerable groups, like elderly, children and disabled people are at risk. Urban planning can help in slowing down the speed of road traffic by traffic calming techniques. Besides, detailed design of urban areas is needed to ensure natural processes of surveillance. This reduces incidences of crime and the fear of it. When a local environment is too intimidating and inconvenient, people use the car more often and social interaction is reduced (Barton & Tsourou, 2000).

Equity
Material deprivation and social and psychological problems of living in poverty can lead to poor health and premature deaths. By providing social and low-cost housing, providing job opportunities, influencing the convenience and safety of neighbourhoods, planning systems can improve movement patterns by providing a range of easily accessible facilities. By these factors local networks and mutual support are enhanced, this stimulates the sense of local community (Barton & Tsourou, 2000).

Air quality
When air quality is improved the incidence of severe lung diseases and asthma is reduced. Besides, it will contribute to people's well-being. To improve air quality planning policies can put local environmental quality high on the agenda. Urban planning actions can involve segregating polluting and noisy industrial zones, promoting cleaner forms of transport, discourage car use and supporting energy-efficient development (Barton & Tsourou, 2000).

Water
In preventing diseases, a good water quality and sanitation are critical. In new develop-

ments urban planning can imposes standards and criteria. Also, it can ensure that new development does not take place in flooding areas (Barton & Tsourou, 2000).

Quality of land and mineral resources
By reducing contamination human health and the quality of environment can be improved. Planning can stimulate the use of recyclable and renewable materials in building processes. Urban open spaces and local food growing activities can be protected, and brownfields and derelict urban land can be redeveloped (Barton & Tsourou, 2000).

Climate stability
Temperature extremes can cause deaths among deprived groups and elderly. A reduction of extremes can help. Due to this extremes in weather the sea level will rise. Urban planning need to take these climate changes into consideration in the development of urban areas, so fewer people will become ill or displaced. To do this human emission of greenhouse gases need to be mitigated. This can be done by stimulating a more sustainable way energy use in buildings and transport (Barton & Tsourou, 2000).

As explained with all determinants of health, urban planning can influence urban health in many ways and at many levels. They are all related to one another, and more than one action is required in the planning policy field. When speaking of the introduction of the automated mobility in an urban environment, a few health determinants are at risk. Like personal lifestyles, accessibility and social cohesion. Due to the ease, comfort and convenience of the autonomous vehicles people



Image 65: Leefstraat (Alders, 2017)

more often take the car. And, because the automated mobility probably will be faster and more convenient than public transport, before- and after transport (which is often an active form) will no longer exist. This does not improve a healthy lifestyle. Besides, due to increased traffic complexity, the possibility to abuse the automated vehicles by pedestrians/cyclists and the continuity of the flows, the flows will be separated (The Boston Consulting Group, 2016). Yet, this results in a decreased accessibility of the road network for pedestrians and cyclists (Stead et al., 2018). Which discourages active travel forms. This might lead to less social cohesion, because there are no safe and accessible environments where people can meet informally (Barton & Tsourou, 2000). If active forms of travelling are under threat, due to automated mobility, urban health is at risk (healthy lifestyles, accessibility, social cohesion). Special attention needs to go out to improving these three determinants at various levels of planning policies.

However, automated mobility, on the contrary, can also contribute to certain health determinants, like safety, equity, air quality and climate stability. Due to the new technologies in the automated vehicles the traffic safety increases. Besides, cars are no longer depended on the driver, who might be distracted (Kennisinstituut voor Mobiliteitsbeleid, 2015). Besides concerning equity, automated vehicles make mobility more accessible to a wider audience as a result of expected lower costs and it is unnecessary to have a drivers licence anymore (Arcadis, 2018). Also, due to new sustainable developments the new forms of traffic, the air will be less polluted. Which creates more attractive and healthy environments, which increases people's sense of well-being (Barton & Tsourou, 2000).

Now, this project explores the possibilities and opportunities of improving urban health with the introduction of automated mobility. This will, probably, already happen due to improved air qualities and noise reduction of the electric vehicles (or other alternative forms of energy). However, due to automated mobility active forms of travelling are under threat, which puts urban health at risk (healthy lifestyles, accessibility, social cohesion). It is needed to focus on the activity and mobility patterns of the inhabitants of neighbourhoods. By planning and designing healthy residential neighbourhoods, by e.g. stimulating and facilitating activity, opportunities will be created to improve urban health. Focussing on improving personal lifestyles, social cohesion, accessibility, in combination with the gained advantages of introducing AM in terms of air quality and safety, healthier neighbourhoods can be created. In this, existing problems need to be taken into account as well.

In the tables of image 66 is set out which problems are already existing, concerning urban health. This is made visible in the left column. In the right column is listed what the introduced benefits will be due to the intro-

duction of automated mobility, in the blue table. In the red table is listed what the introduced problems will be.

The goal is in the end to improve urban health in residential neighbourhood both by improving existing problems and introduced problems. The introduced benefits are a first step in this.

Existing problems	EFFECTS ON URBAN HEALTH	Introduced benefits (AM)
Segregation	Personal lifestyles	More people can use AM/ are included
Poor accessibility (work & services)	Social cohesion	Improved accessibility remote areas
Traffic accidents	Housing	Improved traffic safety
Unequal accessibility (living, work, services)	Work	More people can use AM/ are included
Air pollution (emission)	Accessibility	Less polluting emission - better air quality & global climate
Heavy rainfalls	Food	Less polluting emission - better water quality & global climate
Poor quality/ polluted soil	Safety	Less polluting emission - better soil quality & global climate
Greenhouse effect	Equity	Less polluting emission - better for global climate
	Air quality	
	Water	
	Soil	
	Global climate	

Existing problems	EFFECTS ON URBAN HEALTH	Introduced problems (AM)
Sedentary lifestyles	Personal lifestyles	Convenience AM - less active transport
Segregation	Social cohesion	Increased traffic complexity - less accessibility
Poor housing quality	Housing	Increased mobility (vehicles) & complexity
Poor accessibility (work & services)	Work	Increased traffic complexity - less accessibility
	Accessibility	
	Food	
	Safety	
	Equity	
	Air quality	
	Water	
	Soil	
	Global climate	

Image 66: Existing and introduced problems/benefits urban health (own image)

Designing urban health

To improve urban health in residential neighbourhood existing problems and introduced problems need to be tackled. Here design principles and qualities will be used to in the end design for a healthy environment. All these principles, strategies and qualities will be translated into design interventions (see next paragraph). The introduced benefits are a first step in this. Due to the introduction of the automated mobility the health determinants safety, equity, air quality and global climate have the chance of improving. However, automated mobility on its own will not solve all the existing problems.

Design on macro scale

Climate change is a fact. Most likely the sea level will rise, there will be more heavy rainfalls, but also longer dry periods. Wetter and warmer winters and drier and hotter summers ask for designing in a more sustainable and climate proof way (GroenBlauwe Netwerken, nd.). Health can be influenced by these extreme weather events. Directly by for example heat exhaustion, which will especially affect vulnerable groups like elderly. Also health can be influenced in an indirect way by facilitating the spread of communicable diseases (Pineo & Rydin, 2018). Designing climate proof neighbourhoods constitute collecting and finally discharging water in periods of extreme rainfall. During periods of extreme droughts flora and fauna suffer. Both require managing urban green spaces to anticipate on these periods of extremes to maintain a good ecosystem (GroenBlauwe Netwerken, nd.). Therefore green and blue infrastructures can be should be deployed, because it contributes to better air quality, helps to reduce temperatures (urban heat island effect) and provide shade during heat waves. Green infrastructures can be carried out in many different scales. The different scales of green infrastructure can fulfil different roles, from storing rainwater to reduce flooding, to creating public spaces where people can play and exercise. However, green infrastructure only promotes health and well-being when it is well maintained, if it is neglected this will lead to a reduced safety (Pineo & Rydin, 2018).

Air and noise pollution is mainly caused by traffic. With the introduction automated mobility, alternative fuels will be the norm. This will decrease the air and noise pollution of mobility. However, traffic also creates a serious risk of accidents which can result in death or injury. Traffic accidents are globally the eighth leading cause of death, especially among people aged 15 to 25. People's perception of danger from traffic also influences their travel behaviour. In particular vulnerable groups such as children tend to walk or cycle less due to lurking danger. Effective measure to reduce traffic accidents are for example limiting traffic speeds, especially in residential areas. Urban planning and policies can be used to design safe streets for everyone (Pineo & Rydin, 2018). With the introduction of automated mobility, vehicles will be safer and cause less accidents. In the design for the healthy neighbourhoods it is of is of paramount importance to reconsider infrastructural networks.

Design on micro scale

To improve personal lifestyles, social cohesion and accessibility in neighbourhoods where automated mobility is introduced, one of the main aims is to give more priority to the slow traffic and make the neighbourhood more 'activity friendly and inviting'. By doing this people are more challenged to move, meet more people in an informal way and are services more accessible for a wider audience.

The neighbourhood design will influence activity patterns. The design determines how inhabitants use the city. This is done by designing mixed and dense urban areas, which is walkable and cyclable, and have parks and public spaces for the people (NYC, 2010). The aim is to give priority to slow traffic and create an 'activity friendly and inviting' environments. In these environments activity is a natural part of everyday life. An attempt will be made to establish a relationship between the physical layout of the city and the (un) conscious choice of people to move actively, knowing that moving is not as easy for every resident. In this way more residents can move sufficiently and will comply with the exercise norms (see image 67) (Gemeente Amsterdam, n.d.-a).

Why is this of importance? Because it contributes to a healthier, more attractive, more liveable, more social and an economical vital city. It makes the city healthier because the air will be less polluted and there is less noise nuisance. Also, the inhabitants will be healthier because they are stimulated to move more and meet people in an informal way. It will create a more attractive and liveable image of the city, a place where children can grow up safe and healthy, and adults like to work and recreate. Also, the city will be economical vital because businesses like to settle here (de Bont et al., 2017).

The introduction of automated mobility will

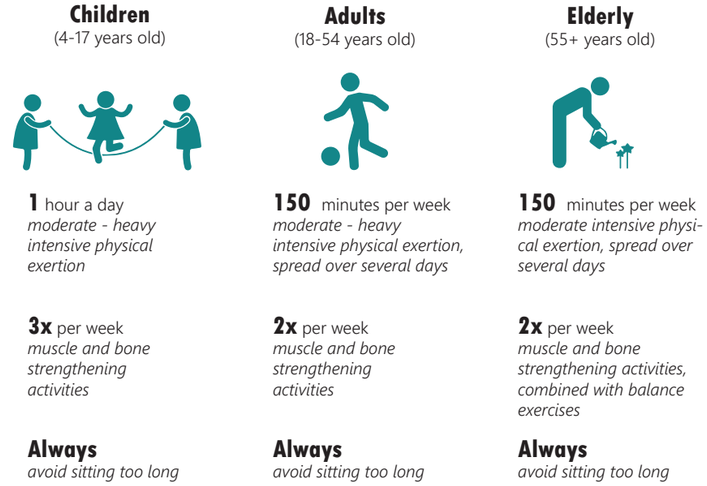


Image 67: Exercise norms
(own image, information from: de Bont et al., 2017)

be the excellent opportunity to rethink the city and make it a more healthy city on various fronts, like sustainability, liveability, safety, and attractiveness.

Design qualities activity
To promote active living through urban design and planning it is essential to develop and maintain five qualities. The five qualities are: density, diversity, design, destination accessibility and distance to transit. The first D, density, reflects on the concentration of facilities and houses in an urban area. The second D, diversity, is a measure for the variety land use in an urban area. Design, the third D, encompasses the characteristics of the street network and open spaces in a neighbourhood. The fourth D, destination accessibility indicates the ease of travel to a certain location. Distance to transit, the fifth D, reflects on the proximity of transport stops or stations (NYC, 2010). ''Walking and transit use (a factor connected to higher levels of physical activity) increase with density, diversity, good design, destination accessibility, and transit access" (NYC, 2010, p. 23).

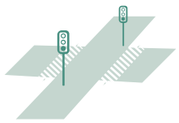
The third D, design, is probably the most inexplicit, it is hard to measure and create. However, progress have been made towards quantifying and defining the components of adequate urban design. Below are five design qualities mentioned which are critical to a good walking and cycling environment, an environment which will activate people:
- ''Imageability: the quality of a place that makes it distinct, recognizable, and memorable.
- Enclosure: this quality refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other vertical elements.
- Human scale: this quality refers to a size, texture, and articulation of physical elements that match the size and proportions of humans and correspond to the speed at which humans walk.
- Transparency: this quality refers to the degree to which people can see or perceive objects and activity -especially human activity- beyond the edge of a street.
- Complexity: refers to the visual richness of a place. The complexity of a place depends on the variety of the physical environment" (NYC, 2010, p. 23).

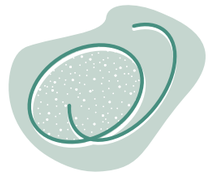
Design interventions
All the principles, strategies and qualities are in the following paragraph translated into design interventions. These are all derived from literature and will be tested in the design. For these design tests later on, recommendations will be put together to help urban designers and planners in designing healthy neighbourhoods in a future with automated mobility.

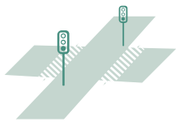
The design interventions are subdivided in the four main themes: walking & cycling, sporting & playing, mobility, and ecology & sustainability.

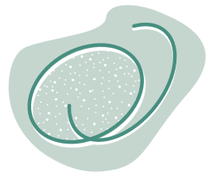
Design interventions

Design principle	Code	Explanation	Image
Walking & cycling			
Land use mix	**1.1**	When planning urban-scale developments, provide for a mix of uses. Evidence suggests that the more schools, grocery stores, offices, residences, and other useful destinations there are in an area, the more likely residents are to walk (NYC, 2010).	
Dense, mixed neighbourhoods	**1.2**	By striving for a compact and mixed local tissue of functions, functions can be accessed quickly and easily on foot and by bike (Dufour, Caers, Baert & Marchal, 2018).	
Accessibility	**1.3**	Public/ open space and networks should be easily accessible and where possible, provide residents with access to public/open space within a ten-minute walk. People with nearby access to parks are more likely to attain higher levels of physical activity (NYC, 2010).	
Fine meshed networks	**1.4**	Neighborhoods have a fine-mesh grid of mixed streets (de Bont et al., 2017). Try to provide pedestrians with the most direct possible routes between destinations and with a choice of routes. Avoid long, continuous blocks (NYC, 2010)	
Clear and interconnected roads and routes	**1.5**	Design well-connected streets with sidewalks and keep block sizes relatively small. Try to provide pedestrians with the most direct possible routes between destinations and with a choice of routes (NYC, 2010). Cycling and	

Design principle	Code	Explanation	Image
		hiking routes are easy to find (Gemeente Amsterdam, n.d.-a).	
Human scale & enclosure	1.6	Giving streets a human scale and sense of enclosure can encourage physical activity (NYC, 2010).	
Safe crossings and routes	1.7	Make bicycle and pedestrian routes and public spaces safe and visible (NYC, 2010). Crossings should be safe for cyclists and pedestrians.	
Parking facilities (bike) - capacity	1.8	There will be sufficient bicycle parking places in both neighborhoods and at facilities. From buildings you can first reach the bicycle parking and then the car parking (de Bont et al., 2017).	
Signage and lighting on streets	1.9	Use on-street markings or signage to visually reinforce the separation of areas for bicyclists and motorists. At crossins, provide signage directing to suggested routes. Provide lights on sidewalks/areas to extend opportunities for activity in the evening (NYC, 2010).	
Wide and well connected sidewalks	1.10	Make sidewalks wide enough to accommodate a range of pedestrian users safely, while not so wide as to feel empty (NYC, 2010)	
Frictionless sidewalks	1.11	Walking and cycling paths and sidewalks are frictionless for vulnerable groups, with bridgeable height differences in the street profile, comfortablere hardening, no unnecessary obstacles and safe crossings (de Bont et al., 2017).	
Sporting & playing			
Parks/open spaces/ public spaces nearby	2.1	Parks and public/ open space should be easily accessible and where possible, provide residents with access to public open space within a ten-minute	

Design principle	Code	Explanation	Image
		walk. People with nearby access to parks are more likely to attain higher levels of physical activity (NYC, 2010).	
Facilities in and around parks/open spaces/public spaces	2.2	In the design of parks and open spaces, provide facilities like paths, running tracks, playgrounds, sports courts, and drinking fountains (NYC, 2010).	
Playing and sport facilities/areas nearby	2.3	There is a diversity of play areas: from small spots in the neighborhood to larger play areas for several age groups (at a slightly larger distance) (de Bont et al., 2017).	
Multifunctional & hybrid areas	2.4	The (playing) areas are multifunctional, for various uses per season and for multifunctional use per part of the day (de Bont et al., 2017).	
Playing and sporting triggers	2.5	The city offers playing and sports triggers. Simple poles, benches and trees often provide sufficient reason for bootcamp, football, urban sports, and are often enough to stimulate the imagination (de Bont et al., 2017).	
Signage/explanation playing and sporting	2.6	When designing playgrounds, include ground markings indicating dedicated areas for sports and multiple use. A recent study found that children who attended schools where the playgrounds were redesigned with color-coded activity zones engaged in more vigorous activity than children in schools without the redesign (NYC, 2010).	
Playing and sporting areas accessible and suitable for everyone	2.7	Play areas are not only suitable, attractive and accessible to children, but for everyone (Gemeente Amsterdam, n.d.-a).	

Design principle	Code	Explanation	Image
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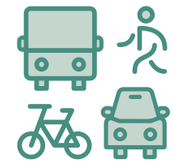
Design principle	Code	Explanation	Image
Mobility			
Separation of speeds	3.1	Transport modes are not mixed if speed and vulnerability differences are too big. The cyclist is separated from the walker on busy approach roads. Vulnerable elderly and children therefore have a safe sidewalk (de Bont et al., 2017).	
Fast traffic around neighbourhood	3.2	Busy and fast routes for car and bicycle around the city districts (de Bont et al., 2017).	
Mixed streets - equal speeds	3.3	Transport modes with equivalent speeds are mixed. Mixing and more self-regulation increase alertness and road safety (de Bont et al., 2017).	
Car-free zones - car is guest	3.4	A limited car traffic pressure is a basic condition. The main goals are that walking and cycling becomes safe and attractive, that there is room to stay in the public space and that the quality of life improves. Motorized traffic is subordinated to this. The car is a guest (Dufour et al., 2018).	
Traffic calming	3.5	Promote walking and improve the overall pedestrian experience through traffic calming measures. Incorporate traffic calming street additions such as curb extensions, medians, and raised speed reducers (NYC, 2010).	
Pick-up/ drop-off places	3.6	Smart planning of pick-up places for packages prevents unnecessary freight traffic through the neighborhoods (de Bont et al., 2017).	
Parking facilities (car) - clustering	3.7	When designing sites that include parking, consider how the provision of parking can affect the use of more active modes of travel such as walking, bicycling, and public transit (NYC, 2010). Parking places should be clustered (de Bont et al., 2017).	
Multimodal nodes - attractive	3.8	A neighborhood is accessible through various transport networks and services. Residents can also travel easily over larger distances without a private car and the neighborhood can be reached multimodal for visitors (Dufour et al., 2018).	
Ecology & sustainability			
Improve green & blue networks	4.1	Wetter and warmer winters and drier and hotter summers ask for designing in a more sustainable and climate proof way. (GroenBlauwe Netwerken, n.d.). Provinding green and blue infrastructures will support biodiversity and help to manage rainwater. The plan also includes green walls, roofs and urban farming through community gardens (RICS, 2018).	
Green routes	4.2	The parks and water are connected via attractive, green routes. Together they form an attractive network between the parks, the water and the landscape for relaxed walking and cycling (de Bont et al., 2017).	
Trees for shade and visual attractive streets	4.3	Include trees to provide shade and visual interest on streets and sidewalks. Trees and other landscape elements contribute to more appealing sidewalks and streets, provide shade in the summer, and can be used to help separate pedestrians from vehicular traffic (NYC, 2010).	
Encourage community gardening	4.4	Besides strengthening ecological networks and contributing to sustainability, community gardens can contribute to creating a sense of community. Community gardeners are more likely to know and trust their neighbours. Gardens also serve as a space for intergenerational and intercultural engagement (Centre for active desing, 2018).	

Image 68: Design interventions (own image)



Image 69: Waterfront park (Sasaki, 2010.)

Healthy neighbourhoods building blocks **156**
Role urban designer **160**
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HEALTHY NEIGHBOURHOODS

Healthy neighbourhoods building blocks

What
To ensure healthy lives and the well-being for the whole population, improving health will remain a global priority. It contributes to realising human potential and helps to create economically vibrant, equitable and inclusive cities (World Health Organisation, 2016). A healthy city is ''one that is continually creating and improving those physical and social environments and strengthening those community resources which enable people to mutually support each other in performing all the functions of life and achieving their maximum potential'' (Pineo & Rydin, 2018, p.8). To build a healthy and safe urban environment, urban planning for healthy behaviours and safety needs to be promoted. Besides, urban living conditions need to be improved. And, a participatory urban governance needs to be ensured. Also, cities need to be built inclusive and accessible. Finally, the urban areas have to be resilient to emergencies and disasters (World Health Organisation, 2010).

Due to the introduction of automated mobility new health opportunities arise, primarily opportunities regarding a new way of distributing space. Therefore, this urban design project focusses on promoting healthy behaviours by rethinking networks. In this, safety for slow traffic should be guaranteed. Besides, it emphasizes on increasing the accessibility of the neighbourhood and its services, mainly by making the neighbourhood more walkable and cyclable. Also, the redesign of the neighbourhoods creates opportunities to make the urban areas more resilient and sustainable. On top of this, the introduction of autonomous vehicles offers new kinds of opportunities in terms of safety, sustainability and inclusiveness.

Why
Improving the urban health of a community by designing healthy neighbourhoods, the health of individuals will be improved. More exercise in a healthy and safe environment leads to an extension in number of healthy years that we live and to a higher quality of life when we are older. It also results in less chance of getting non-communicable diseases, and a improvement of someone's well-being (Gemeente Amsterdam, n.d.-b).

Besides, a healthy city is a more attractive, more liveable, more social and an economical vital city. It makes the city healthier because the air will less polluted and there is less noise nuisance. Also, the inhabitants will be healthier because they are stimulated to move more and meet people in an informal way. It will create a more attractive van liveable image of the city, a place where children can grow up safe and healthy, and adults like to work and recreate. Also, the city will be economical vital because businesses like to settle there (de Bont et al., 2017).

For whom
The healthy city is there for all who live in the city. All who work, brings the children to school, does their shopping, sits on the couch, walks around in the park, just catches the bus and plays on the street. In short: the healthy city this there for all its inhabitants in all age groups (Gemeente Amsterdam, n.d.-b). Special attention is paid to vulnerable residents who already cope with health issues, focussing on the already existing situations and problems. In the future, with the introduction of automated mobility, new threats might occur for other groups of residents.

How
An healthy city is organized in such a way that all residents are consciously or unconsciously invited to be active: by playing, by traveling, by exercising, by meeting and by recreation(Gemeente Amsterdam, n.d.-b). Besides, a healthy city is situated in a healthy environment, with good air, water, and soil quality. It is resilient and sustainable.

Healthy city building blocks give city makers tools to take health into account in a design or in the redesign of neighbourhoods, parks, streets and squares. The building blocks form the ambitions in designing healthy neighbourhoods in Almere. The main building blocks of a healthy neighbourhood in this project are listed below.

> 1
The healthy neighbourhood gives ample space to the slow traffic (cyclist and pedestrian), and the fast traffic will not be dominant.

In a lively and attractive city - a city with a high density - people like to go outside. They walk or cycle to go to work, the shops, school or the café. That is why we aim for neighbourhoods with a mixed facility pattern so that facilities are easily accessible on foot and by bicycle (Gemeente Amsterdam, n.d.-b). The urban design at micro scale is critical to a good walking and cycling environment, an environment which will activate people (NYC, 2010).

Slow traffic will not be obstructed by the fast mobility forms. Fast forms of mobility will not dominate the streets anymore. Cars, buses, taxi's, etc. drive around slow traffic zones. Slow traffic will get the full priority which allows people to move and meet in a safe environment. When designing the public space and the routes through the city, the cyclist and the pedestrian are considered first.

> 2
The healthy neighbourhood triggers and invites to move and meet.

The neighbourhood design will influence activity patterns. The design determines how inhabitants use the city. This is done by designing a mixed, diverse and dense urban areas, which are walkable and cyclable, and have parks and public spaces for the people (NYC, 2010). The aim is to give priority to slow traffic and creating an 'activity friendly and inviting' environments. In these environments activity is a natural part of everyday life. Establishing the relationship between the physical layout of the city and the (un)conscious choice of people to move actively, knowing that moving is not as easy for every resident. Doing this, people are challenged to move more, meet more people in an informal way and are services more accessible for a wider audience (Gemeente Amsterdam, n.d.-a).

> 3
The healthy neighbourhood is a sport- and playground.

For children, adults and elderly, the city, the streets, the parks, the squares and the water trigger to play and exercise. In order to play you need to feel safe, you need space and the environment needs to stimulate you to come up with a game yourself. Not only there is a sufficient opportunity to move in neighbourhoods, the quality of public space is also crucial. Green plays a major role in this. Green areas should be in the right place, well accessible, safe and well integrated in the neighbourhood. Green spaces do not have to be big. Small, clear places are just as nice. The design of the public space triggers people to

play a game of football, a walk with the dog or play hide and seek, etc. Sporting and playing locations are in the right place close to the target group, visible, inviting and triggering (Gemeente Amsterdam, n.d.-b).

> 4
The healthy neighbourhood comprises a healthy and clean environment, it is sustainable, resilient and climate proof.

Climate change resulting in wetter and warmer winters and drier and hotter summers ask for designing in a more sustainable and climate proof way. Designing climate proof neighbourhoods requires managing urban green and blue infrastructure to anticipate on extremes to maintain good ecosystems. Improving ecosystems will be beneficial for the health of the community but also support the flora and fauna (GroenBlauwe Netwerken, n.d.).

> 5
The healthy neighbourhood is accessible and everyone is included.

In the development of urban areas a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018). This accessibility should mainly be focussing on the accessibility of these locations by active modes of travelling. Besides, the accessibility is also related to the people. All services should be accessible for everyone, and no one should be excluded.

Role urban designer

Urgency
Cities are becoming more and more crowded. This leads to a global challenge in accommodating the growing numbers of residents in the city and how to ensure the residents' health and well-being. The growing cities try to cope with health issues related with pollution, disease and overcrowding. However simultaneously, cities in developed countries encounter new health challenges which arise due to the arrangement of our cities, transport and the lifestyles we are maintaining (Pineo & Rydin, 2018). Our lifestyle decisions shape health but choices are informed by social and economic opportunities, education and the quality of the environment (Barton & Tsourou, 2000).

For more than a century, property practitioners made all decisions about the built environment. Choices in this decision-making process are not always made based on health considerations but are also informed by costs of developments. Given the increasing pressure on cities where land is more intensively used, property needs to be deployed more efficient and more affordable than ever. However, this is not sustainable when the cities will not be liveable anymore (Pineo & Rydin, 2018).

Link – recover
During the end of the 19th century, it had been recognized that the physical environment is an important determinant of urban health, mainly focussing on pollution, overcrowding and infectious diseases. However, over the years the link between the urban environment and the urban health diluted a bit. Now there is growing evidence that the physical environment has its influence on the health and well-being of communities, both in a positive and negative way. It is therefore important the recover the link between both fields (Pineo & Rydin, 2018), because many urban planners do not include health issues in their designs. Yet, the quality of the environment is one of the most important determinants of health. On top of this, health is an important driver for economic productivity (Barton & Tsourou, 2000). The knowledge the built environment practitioners have about working across public and private sectors can be used to integrate health promoting methods into new developments at many different scales (Pineo & Rydin, 2018).

Impact urban design
Although it is hard to identify the exact impact of physical environment measures on health, this does not mean that the urban environment does not influence health and well-being. Many people believe that genetics and healthcare are the main drivers of health. However, the social and physical environment play at least an as important role. To illustrate, globally 23% of the deaths each year are caused by the physical environment. Built environment practitioners can contribute in maximising positive health outcomes and reducing negative health outcomes by the design and development of urban areas and building (Pineo & Rydin, 2018).

Benefits long and short term - finance
Eliminating infectious diseases in outskirts of emerging cities by improving the development standards will be probably experienced immediately. Resulting in all kinds of benefits on the short term. However, in developed countries these benefits tend to occur on the long term because of the healthier and extended lives. Therefore, it is understandable that, in this time of strained financial resources, cost will be incurred in more pressing cases because investments in the urban environment have no obvious immediate return (Pineo & Rydin, 2018).

However, it is maybe wise to reconsider. The number of people with chronic diseases is continuously rising and this imposes heavy costs, mainly in the (social) health care. Promoting physical activity through urban design at many scales is one of the most effective measures to improve urban health and reduce chronic diseases and obesity. On top of this, strategies in reducing air pollution will also be highly impactful in reducing diseases worsened by poor air quality. Besides, in the development of urban areas a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018).

But health and well-being should not be a finance argument. It is critical to take appropriate measures in the short term to prevent human problems and enormous financial costs on the long term (Pineo & Rydin, 2018). Where health influences the quality of life of the people right now, planning for urban health is about designing for future generations (Barton & Tsourou, 2000).

How
The urban environment influences health and well-being on many levels and by many factors, both directly and indirectly. On the macro scale of the city health is influenced by e.g. air pollution, on the micro scale health is influenced by e.g. the design and maintenance of the public space. There are many departments in the city government responsible for managing the urban environment. It is therefore important that stakeholders work both independently and together to improve health in cities (Pineo & Rydin, 2018).

When planning healthy urban areas, the planning practices that are used to improve health and well-being are comparable to the principles used in sustainable development. There is a focus on humans and the environment in the planning practices, rather than focussing on only buildings and economics (Barton & Tsourou, 2000).

More advantages
Built environment practitioners influence social, economic and physical environments and how the city functions. They play a central role in securing conditions and addressing problems in the cities which will support health and well-being (Barton & Tsourou, 2000). So, urban planners and designers do not only improve health but also have an affect on the wide-ranging social and economic infrastructures, which also affects health. Around 80% of the health of the community could be determined by urban planning, if considering the wider impact of urban planning programmes and policies (Pineo & Rydin, 2018).

Strategy

The scheme of image 72 elaborates on how to tackle the existing and occurring problems due to the introduction of AM, and how to achieve the healthy city building blocks/ambtions.

Here it focusses on the possibilities within the field of urbanism, interventions which can made in or for the urban environment. First there are 'analogue' design interventions which will be deployed in the physical urban environment. On the other hand, technological interventions will be deployed by the scenario determinants, which determine the manifestation of autonomous vehicles in the city. The scenario determinants will inform the scenarios and affect urban health and improve it when used in the right way. All interventions are based upon theory and will be tested in the design. Afterwards recommendations will be set up to guide urban planners and designers in designing healthy neighbourhoods in a future with automated mobility.

On page 149-153 the design interventions for this project are listed. On page 122-131 the scenario determinants are listed.

In the scheme of image 72 it is made visible that the design interventions can be deployed in an early stage within the conservative scenario. Those will carry out in the future. Retroactively the scenario determinants will be deployed in a later stage, the progressive scenario, because only here the automated mobility is fully embraced and implemented. However, it is needed to already steer the scenario determinants into the right direction, by means of for example policies, to come to a favourable result in the end.

The design of the two neighbourhoods will first be based on the progressive scenario. With information gained from this design could be stated which determinants and interventions should be deployed in the earlier scenarios.



Image 70: Design interventions (Landezine, 2015)



Image 71: Scenario determinants (Volvo, n.d.)

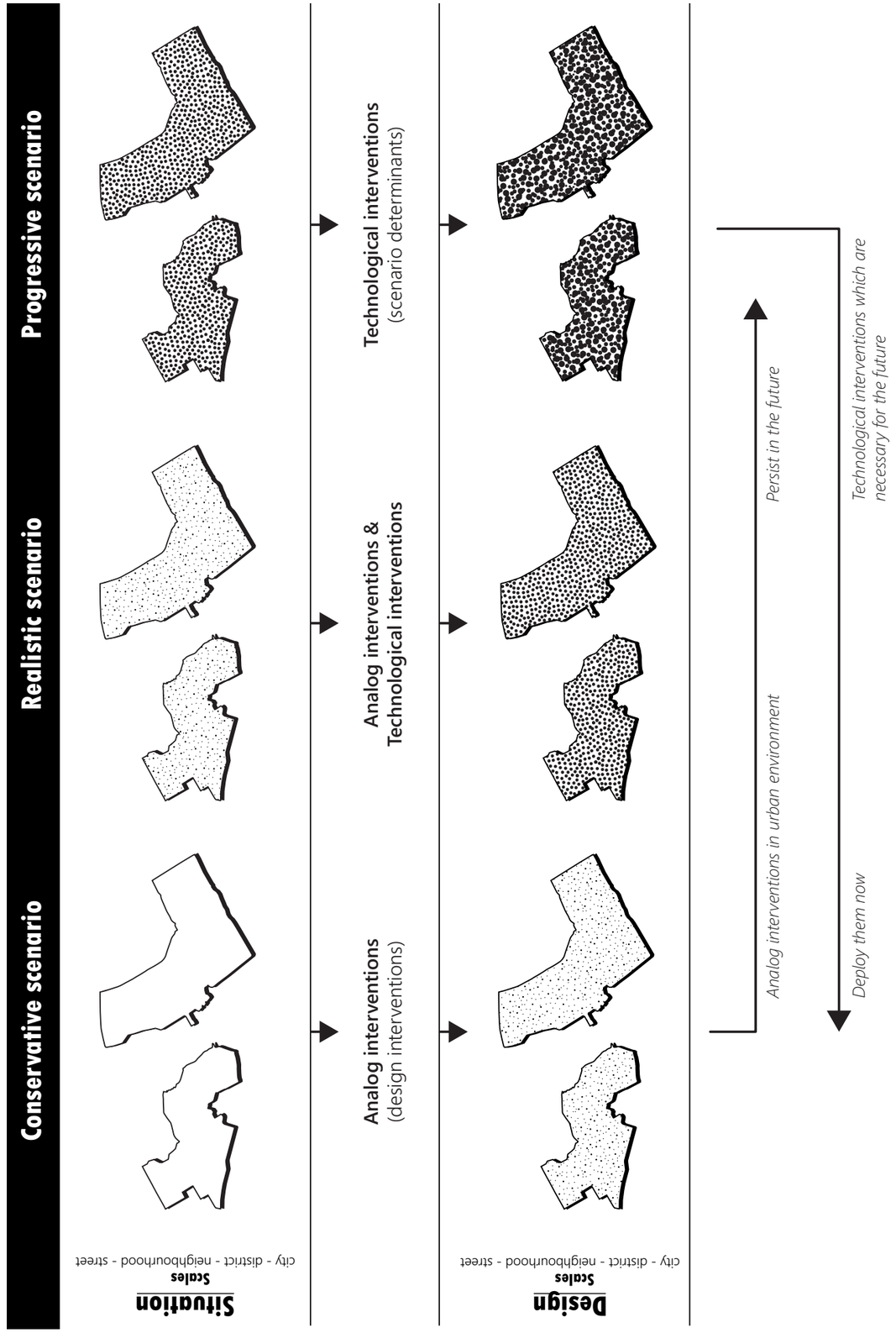


Image 72: Matrix strategy (own image)



Image 73: Automated vehicles (weburbanist, n.d.)

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AUTOMATED MOBILITY

Development automated mobility

Many people think that automated mobility is an innovation of recent history. However, this is not quite the case. The development of self-driving cars started in the 1920s (Boekraad, n.d.). Researchers have been working on prototypes for decades (Swinhoe, 2017). In 1925 the first self-driving car could be seen on the streets of New York City. Houdina Radio Control, which was a radio equipment drove this first car which was controlled remotely by a transmitting antenna (Boekraad, n.d.; Swinhoe, 2017). The car was called the Linrrican Wonder, see image 74.1.

During the First and Second World War, most of the development had been put on hold. But from the 1950s on, experiments with autonomous cars started again (Boekraad, n.d.). There have been countless attempts. For example, there were experiments with putting cables in the road, trying to steer the cars through magnetism and electronic signals (Swinhoe, 2017). RCA were the first successfully carrying out this system. First with mini cars and later on a full-size system (Wikipedia, 2019).

Throughout the 60s and 70s, General Motors claimed to have equipped a vehicle with electronic systems that took over while driving, which allowed the driver to do something else. The vehicle was called the Firebird and was able to cover long distance by the electronic systems present in the car, see image 74.2. From 1980 on the first prototypes of independently driving cars actually came to the public roads. In 1986, the first fully autonomous vehicle, the Robot Car "VaMoRs", ran at a speed 96 kilometres per hour (Boekraad, n.d.).

At the same time, in the United States DARPA funded the Autonomous Land driven Vehicle (ALV) project, see image 74.3. New technologies such as Lidar (Laser Imaging Detection And Ranging), autonomous robotic control and computer vision were used in this project. Those were used to guide a robotic vehicle at a speed of 31 kilometres per hour. By 1987, senor-based road maps and off-road map were installed in the ALV. In 1989, the Carnegie Mellon University experimented with using neural networks to steer the vehicle. These ideas from the basis of controlling systems and strategies nowadays (Wikipedia, 2019).

In the 80s and 90s, the first sensor-based navigation systems came on the market. The American Congress approved in 1991 a proposal for the development of autonomous vehicles and its associated (technical) infrastructure (Boekraad, n.d.).

In 1994, two vehicles drove more than 1,000 km in the area of Paris on three-lane high ways in heavy traffic situations. They established speeds of 130 kilometres per hour and demonstrated free driving, convoy driving and lane changes. However, this was done semi-autonomously because human interventions were sometimes needed. The vehicles were called VaMP and Vita-2 and were developed by Daimler-Benz and Ernst Dickmanns (Wikipedia, 2019). The VaMP is showed on image 74.4.

The subsequent year Navlab project of the Carnegie Mellon University established distances of 5,000 km cross country journeys. Here, more than 98% was autonomously controlled. The car made use of neural networks which controlled the steering wheel. Throttle and brakes were controlled by human be-



Image 74: Timeline AM (sources see next page)

cause of safety considerations. The project was called "No hands Across America" (Wikipedia, 2019), shown on image 74.5.

The world's first driverless vehicle was the ParkShuttle, which was introduced in 1997. The vehicle used artificial reference points which were laid into the road to verify its position. In the vehicle there were no pedals or was no steering wheel present, nor there was a steward on board. Two pilots were done in the Netherlands, one of them at Schiphol Airport. The driverless vehicle was used to move people across the airport and carried people of the general public (Wikipedia, 2019). The Park Shuttle is shown on image 74.6.

In 2004, DARPA introduced the first Grand Challenge. A competition where self-driving vehicles could compete on a long-distance track. In the first year none of the fifteen participants could complete the 150-mile course. In the following year five managed (Swinhoe, 2017), see image 74.7.

In 2009 Google started the development of its own self driving car. However, this was not yet announced to the public by then, they started privately (Wikipedia, 2019). A Google car is shown on image 74.8.

Autonomous Piaggio vans drove in 2010 from Parma, Italy to Shanghai, China, covering a distance of 16,000 km, see image 74.9. The vans took part in the VisLab Intercontinental Autonomous Challenge. Within the 100-day challenge the first autonomous vehicle accident occurred. However, the accident was caused by human error (Swinhoe, 2017).

Since 2010 the development of self-driving cars took a flight. The technological development of the 20th century is so big that news is released almost daily (Boekraad, n.d.). Google introduced their own self driving pod, Tesla started offering in 2014 its Autopilot feature, etc. More and more companies are developing their autonomous technologies like Uber, Lyft and Baidu. In the meantime, car incumbents like Volvo, Ford and BMW are working toward commercial self-driving cars. They will be on the roads sooner as we think (Swinhoe, 2017), see image 74.10-74.12.

Image 74.1: American Wonder (Engelking, 2017)
Image 74.2: General Motors' Firebird III (Flickr, 2012)
Image 74.3: Alvinn (Silver, 2017)
Image 74.4: VaMP (Universität der Bundeswehr München, 2016)
Image 74.5: No hands across America (Carnegie Mellon University, 2017)
Image 74.6: ParkShuttle (Vink, 2005)
Image 74.7: DARPA Challenge (Lyons, 2007)
Image 74.8: Google car (Karen, 2012)
Image 74.9: VisLab (Stu, 2010)
Image 74.10: Autopilot Tesla (Paton, 2019)
Image 74.11: Google self-driving car (Lloyed, 2016)
Image 74.12: BMW Vision iNEXT (Luxuryarabia, 2019)

Collage conservative scenario

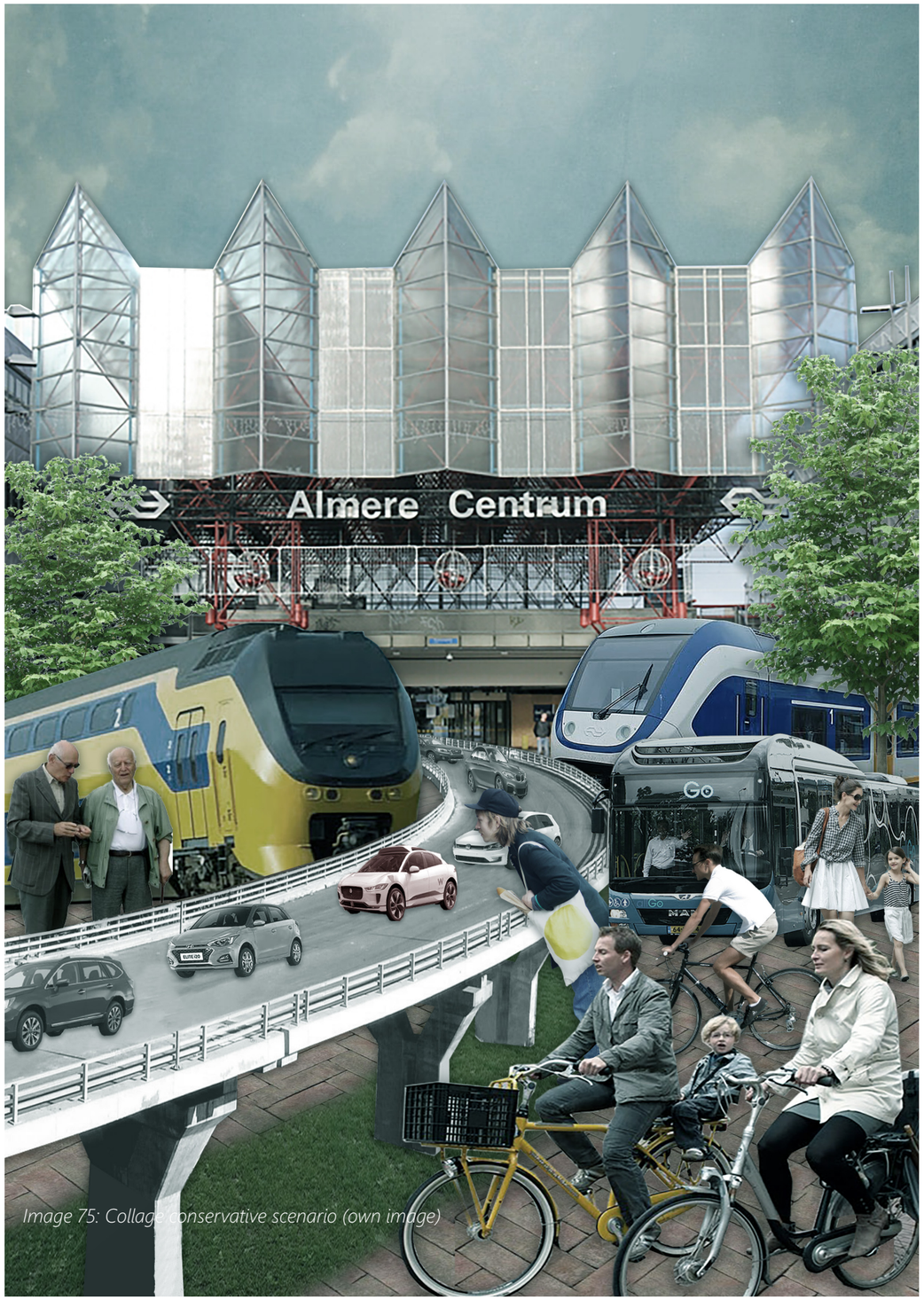


Image 75: Collage conservative scenario (own image)

Automated mobility scenarios

In this paragraph, the three scenarios of a future with automated mobility are described and visualized in a collage of each scenario.

Conservative scenario
Transition phase 1
This scenario will play from now until probably around 2020-2040. Before cars start to drive fully automatic, there is a transition period in which vehicles with advanced driver-supporting systems can take over tasks on motorways and highways. The driver must still actively pay attention while driving. In this transition phase the interaction between driver and vehicle plays a crucial role. In this initial phase, the interaction between man and machine will still be poor (Kennisinstituut voor Mobiliteitsbeleid, 2017).

When the interaction between man and machine does not develop well, for example because the attention of drivers is blurred when monitoring the driving task, then unsafe situations can arise. This could undermine the support for self-driving technology and the sales and profitability of this technology. When the interaction starts to be positive, the development towards more advanced and more autonomous automatic vehicles will most likely continue after several successful 'man-machine' years. It is also possible that if people and machines go well together and everyone is satisfied, the further development towards more advanced self-driving vehicles will be delayed (Kennisinstituut voor Mobiliteitsbeleid, 2017).

During this phase, there will be more and moresystems that support the driver. Leading to more vehicles which are equipped with smart systems in and around the vehicle that help the driver to drive easier, safer and more sustainable. This may concern systems that 'unburden' drivers (driver support systems), such as navigation systems and fatigue detection, but also systems that help the vehicle (vehicle support systems), such as speed control and lane departure warning. As smart technology continues to develop, 'connected' technology will be used more, for example via Wi-Fi or mobile networks (Kennisinstituut voor Mobiliteitsbeleid, 2017).

In addition, the cooperative technology will also penetrate further. Cooperative technology allows vehicles to communicate among each other (vehicle-to-vehicle), with infrastructure along the road (vehicle-to-infrastructure) or with the cloud (vehicle-to-cloud). This allows vehicles to drive with a smaller distance between each other. Which will probably result in fewer traffic incidents. All of this can lead to shorter travel times (fewer traffic jams) and improved road safety and air quality. Important attention and discussion topics for cooperative driving are privacy considerations, the ownership of data and the security thereof (Kennisinstituut voor Mobiliteitsbeleid, 2017).

At the end of this phase investments will be made in the required hardware and software to enable exchange of information with the environment. This may happen in stages, starting on motorways and later on all other major roads outside urban areas (Kennisinstituut voor Mobiliteitsbeleid, 2017).

In order to prevent the spectre of mass accidents, it is essential that data and systems are safe and well protected against disruptions and cyber-attacks. It is important that there are good setback options, such as back-up systems that allow vehicles to drive through when disrupted, and measures that allow vehicles to stop safely. It is important that a sufficient data space is available at all times. If mobile network capacity is also used for other purposes (e.g. mobile internet), good agreements must be made about this. Finally, attention must also be paid to the

Collage realistic scenario

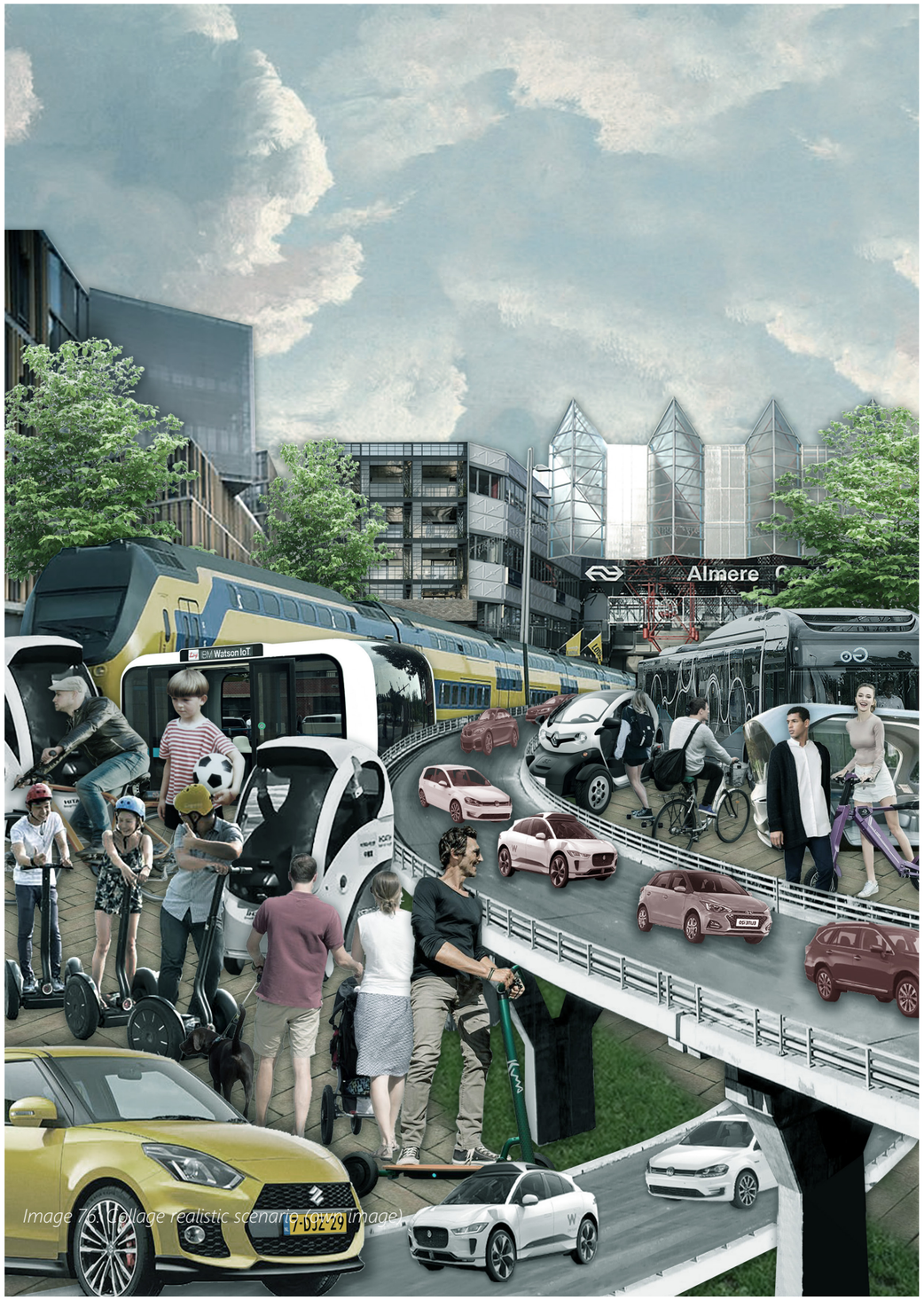


Image 76. Collage realistic scenario (own image)

development and standardization of software (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Besides, during this phase, experiments on the levels of automation will probably be carried out. In this short-term phase, experiments are also taking place with self-driving technology, which will only be on the market in the longer term. The aim is to learn from these pilots given future market introduction (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Realistic scenario
Transition phase 2
The following scenario (from ± 2040 on), which covers the next phase in transition. The number of passenger cars with advanced cooperative systems is rapidly increasing after an initially slow start. Middle class cars are also equipped with it. The number of roads where automatic driving is possible is gradually being expanded at this stage: first only motorways and then also other roads in the built-up areas. The digital infrastructure is also rolled out in phases. The priority of highways is related to safety considerations: motorways have different, physically separated lanes, other than through-roads outside the built-up area (Kennisinstituut voor Mobiliteitsbeleid, 2017).

In this phase, various car brands start offering level 3-4 systems in their premium models. This means that drivers outside the built-up area no longer have to drive themselves; the technique takes over. Drivers can now spend their 'highway travel time' on other things such as reading, working, skyping and gaming. The vehicles use the already present cooperative technology for vehicle-to-infrastructure and vehicle-to-cloud. The expectation is that this vehicle technology will gradually become cheaper for level 3-4. This will reduce the sales of new vehicles with level 1-2 technology (Kennisinstituut voor Mobiliteitsbeleid, 2017).

An important characteristic of this transition phase is that vehicles with different levels of automation will mix. This phase can take a substantial period, perhaps a few decades (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Now that more and more automatic vehicles (level 3-4) came on the road and less advanced vehicles have slowly been phased out. On the national and provincial roads, a relatively high degree of automation has been achieved, facilitated by the government. A significant minority of drivers prefer to keep the wheel in their own hands. People have to drive themselves in cities. Here we also find the traditional forms of public transport. Metros, trams and trains and still play an important role in the city. Those do not need drivers anymore, because they drive on fixed tracks. Buses are still present to a limited extent. In addition, in some cities automatic pods run on fixed routes in the 'last mile' transport to and from stations (Kennisinstituut voor Mobiliteitsbeleid, 2017).

A considerable number of people still own a car. At the same time, car sharing is becoming also more popular. There are various providers ('fleet managers') and platforms (like e.g. Uber and Lyft) that compete on price and quality. Some people share their car privately. The shared vehicles will be used for both short and long-distance journeys. In addition, the shared vehicles are becoming part of an integrated multi-modal transport system. Users can pick up a shared vehicle or leave it on P&R sites at major public transport hubs. The development is facilitated by the emergence of fully integrated payment systems. (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Fully automatic door-to-door transport is not yet possible at this stage. Automated vehicles

Collage progressive scenario



Image 77: Collage progressive scenario (own image)

are only allowed to drive automatically on roads outside the built-up area (level 3-4). Besides, the support is too small. Within the city, the driver has to take over the wheel himself (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Progressive scenario
Transition phase 3
The step from level 3-4 to level 5 will depend on the development of the technology. The switch from level 3-4, in which cars drive safely autonomous on motorways, to level 5, where they will always drive fully automatically everywhere, is huge. The progressive scenario might start around 2060, but this can also be a few decades later. In the intervening decades level 4 will be the norm (Kennisinstituut voor Mobiliteitsbeleid, 2017).

In the intervening period, governments can act in two ways:
• Doing nothing and waiting for level 5 to enter the market automatically;
• Extend the (road)infrastructure on which level 3-4 functions, for example certain routes within cities (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Governments will probably choose the second option if they know that level 5 is still far away. By making the infrastructure suitable for automatic driving on certain routes within cities, they can also exploit the positive effects of the period when level 4 is the norm. Like the increased traffic flow and new time spendings of drivers. If necessary, there will be physical separations between car and bicycle traffic and crossings will be avoided. For the transition within cities from automatic to non-automatic driving, a transition zone is set up, in which drivers receive a signal in time. They have to take over control again (Kennisinstituut voor Mobiliteitsbeleid, 2017).

When level 5 vehicles have entered the market, this 'gadget' is first only for early adopters, for whom the high initial costs are no problem. After that, the number of fully automated vehicles (level 5) will increase considerably and less advanced vehicles will be slowly phased out. The self-driving car is equipped with all kinds of gadgets and is fully tailored to the wishes of the owner (Kennisinstituut voor Mobiliteitsbeleid, 2017).

Besides there will also be fully automated shared vehicles on the market. Providers of shared vehicles purchase these level 5 vehicles and gradually phase out their less advanced (level 3-4) vehicles. The vehicle sharing companies focus on different concepts. Some focus on luxury shared cars where you will ride alone, while others offer cheap and easy services from A to B, not only vehicles but also the rides are shared. Mobility is a service and self-driving cars are always and everywhere available (Kennisinstituut voor Mobiliteitsbeleid, 2017).

The more traditional public transport is put under pressure. Due to the convenience and comfort of the fully automated car and the possibility to arrange automated door-to-door transport. More and more bus services are disappearing, but automated tram lines also have a hard time. Only on 'thick streams' do regular services such as metros and (high-speed) trains flourish (Kennisinstituut voor Mobiliteitsbeleid, 2017).

The introduction of the fully automated vehicles offer new opportunities to rethink the city and its space distribution. Because vehicles do not need to be parked in streets anymore. There is more space for slow traffic but also space for strengthening green and blue infrastructures.

Patterns conservative scenario

The conservative scenario will take place in the first time frame, approximately between 2020-2040. This stage is comparable to the situation where we live in now. Automated vehicles will gently enter the market.

In this time frame more and more vehicles will be equipped with smart systems in and around the vehicle that help the driver to drive easier, safer and more sustainable (Kennisinstituut voor Mobiliteitsbeleid, 2017).

These systems will support the driver both on highways as on normal roads.

Besides this, some vehicles will drive around autonomous on highways, but this is still a minority. While driving autonomous the driver is still obliged to pay attention. This means that during this phase vehicles cannot drive around independently, because a driver is needed. Most of the cars will still be parked in front of the door or on the street.

Traditional forms of traveling, like non-automated cars and public transport will exist along new forms of traveling.

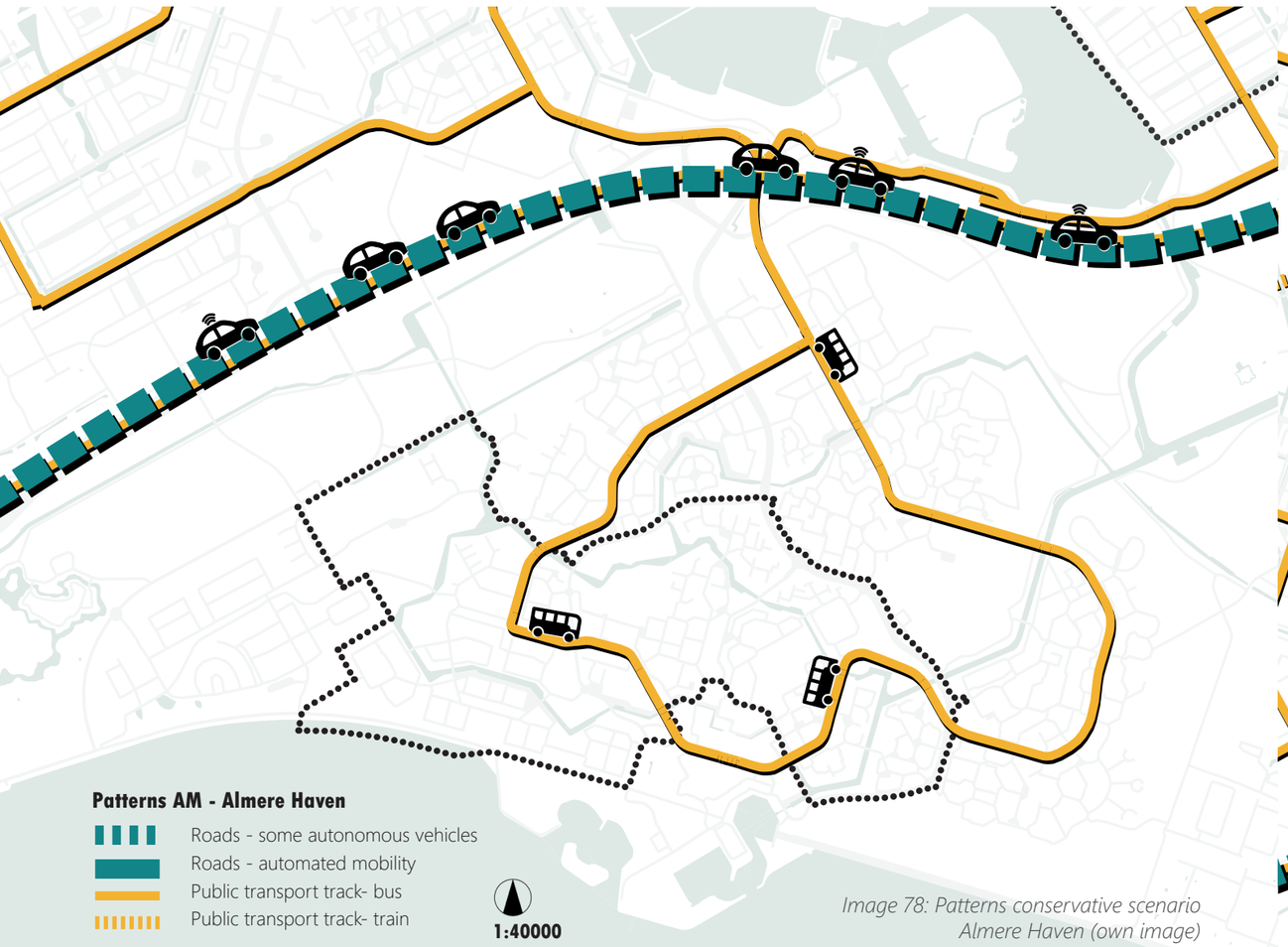


Image 78: Patterns conservative scenario Almere Haven (own image)

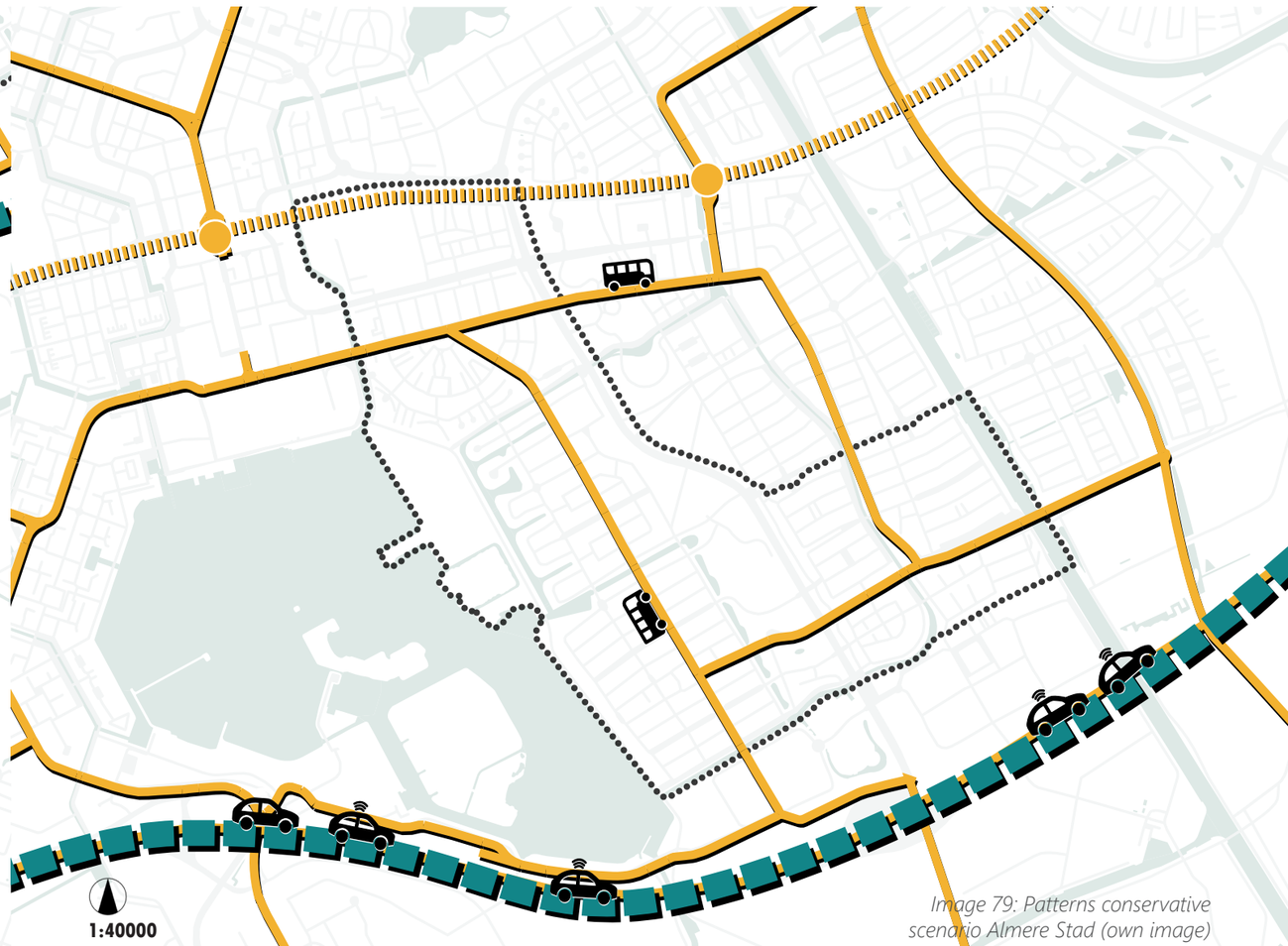


Image 79: Patterns conservative scenario Almere Stad (own image)

Patterns realistic scenario

The realistic scenario will take place in the second time frame, approximately between 2040-2060. However this phase can also be longer depending on when the switch from level 3-4, in which cars drive safely autonomous on motorways, to level 5, where they will always drive fully automatically everywhere, will take place. In the intervening decades (during this phase) level 4 will be the norm (Kennisinstituut voor Mobiliteitsbeleid, 2017)

During this phase all vehicles will drive autonomous on highways, and some 'off-highway'. However, in the neighbourhood itself autonomous driving is still not the norm. The driver has to pay attention while driving in busy areas. This means that vehicles will not be allowed to drive around independently, because a driver is required. Therefore, most of the cars will be parked in front of the door or in the streets.

However, at the same time, car sharing is becoming also more popular (Kennisinstituut voor Mobiliteitsbeleid, 2017). Those cars will be parked in central hubs.

This stage is an accumulation of different forms of traveling. All new forms and all traditional forms of traveling exist along each other. This results in a certain chaos in mobility. The end of this period will also be the tipping point for fully implementation and embracement of the autonomous vehicles.

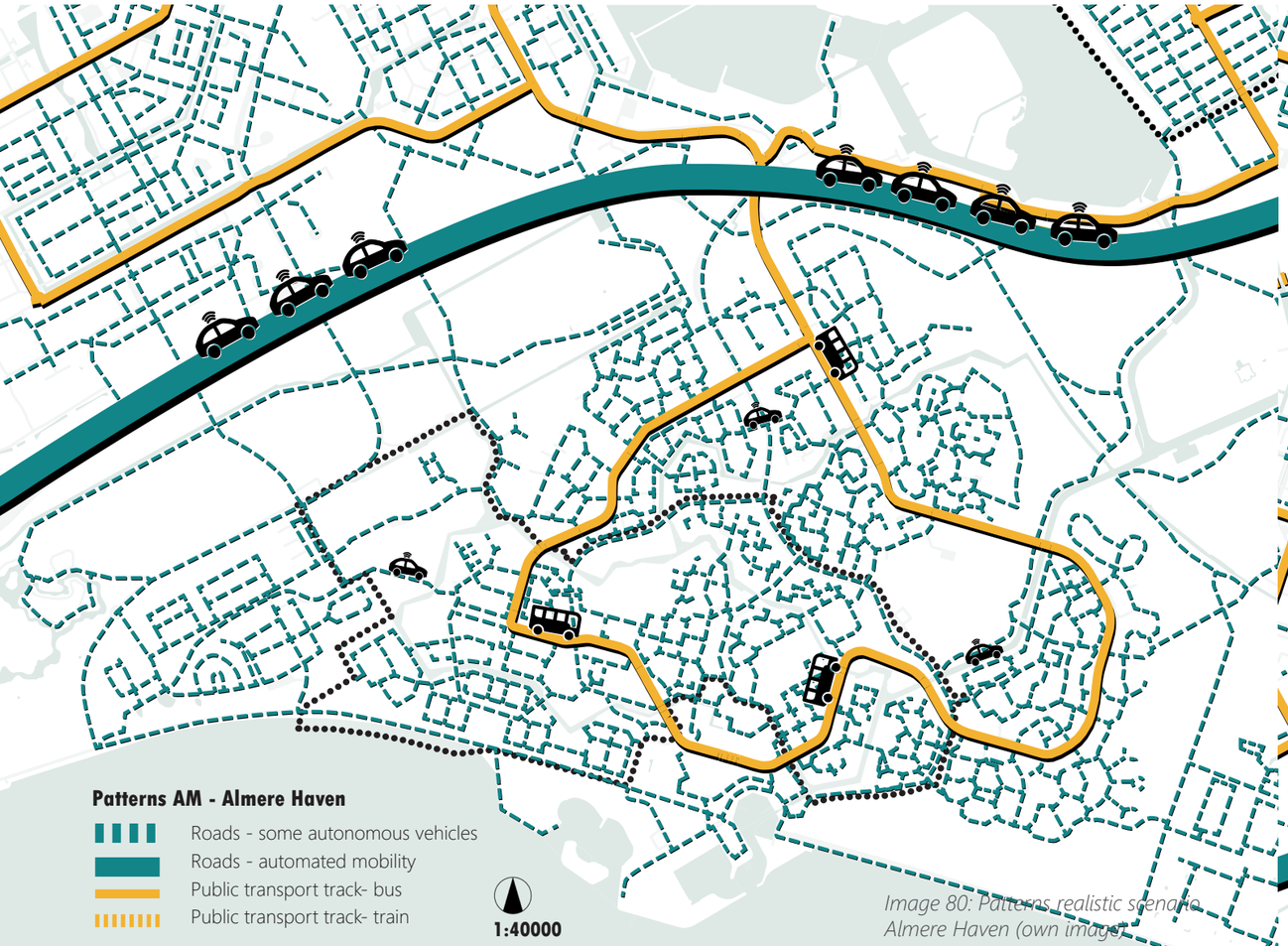


Image 80: Patterns realistic scenario Almere Haven (own image)



Image 81: Patterns realistic scenario Almere Stad (own image)

Patterns progressive scenario

The progressive scenario will take place the third time frame 2060> (but maybe later, see previous paragraph). In this stage the fully automated vehicles (level 5) will be fully implemented and embraced.

All vehicles will be driving around autonomous, everywhere. The automated vehicles can drive around independently. Meaning that there is no driver required in the vehicle to move. The driver is now a passenger of the vehicle. A automated vehicle can pick you up, and you will be delivered to your destination. Afterwards it drives to a central parking area or is picking up or dropping of someone else. (Kennisinstituut voor Mobiliteitsbeleid, 2015).

The more traditional public transport is put under pressure. Due to the convenience and comfort of the fully automated vehicle and the possibility to arrange automated door-to-door transport (Kennisinstituut voor Mobiliteitsbeleid, 2017). Public transport is hardly in use anymore.

The bigger automated vehicles are not allowed everywhere. They will be allowed limited number of roads. On all the other roads the slow traffic will get the full priority. Smaller automated vehicles can drive on these roads, however they have to adapt to the slow traffic.

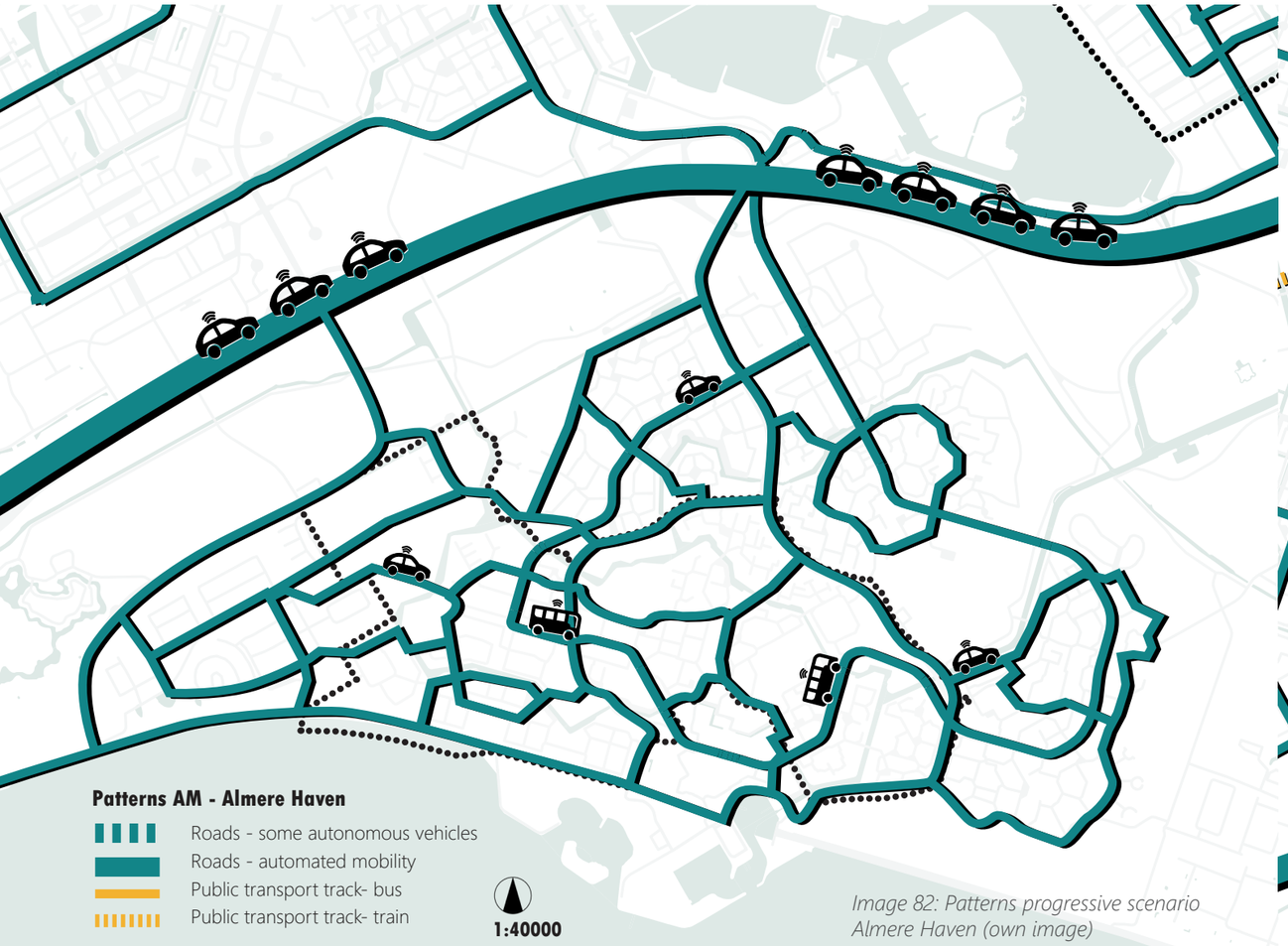


Image 82: Patterns progressive scenario Almere Haven (own image)

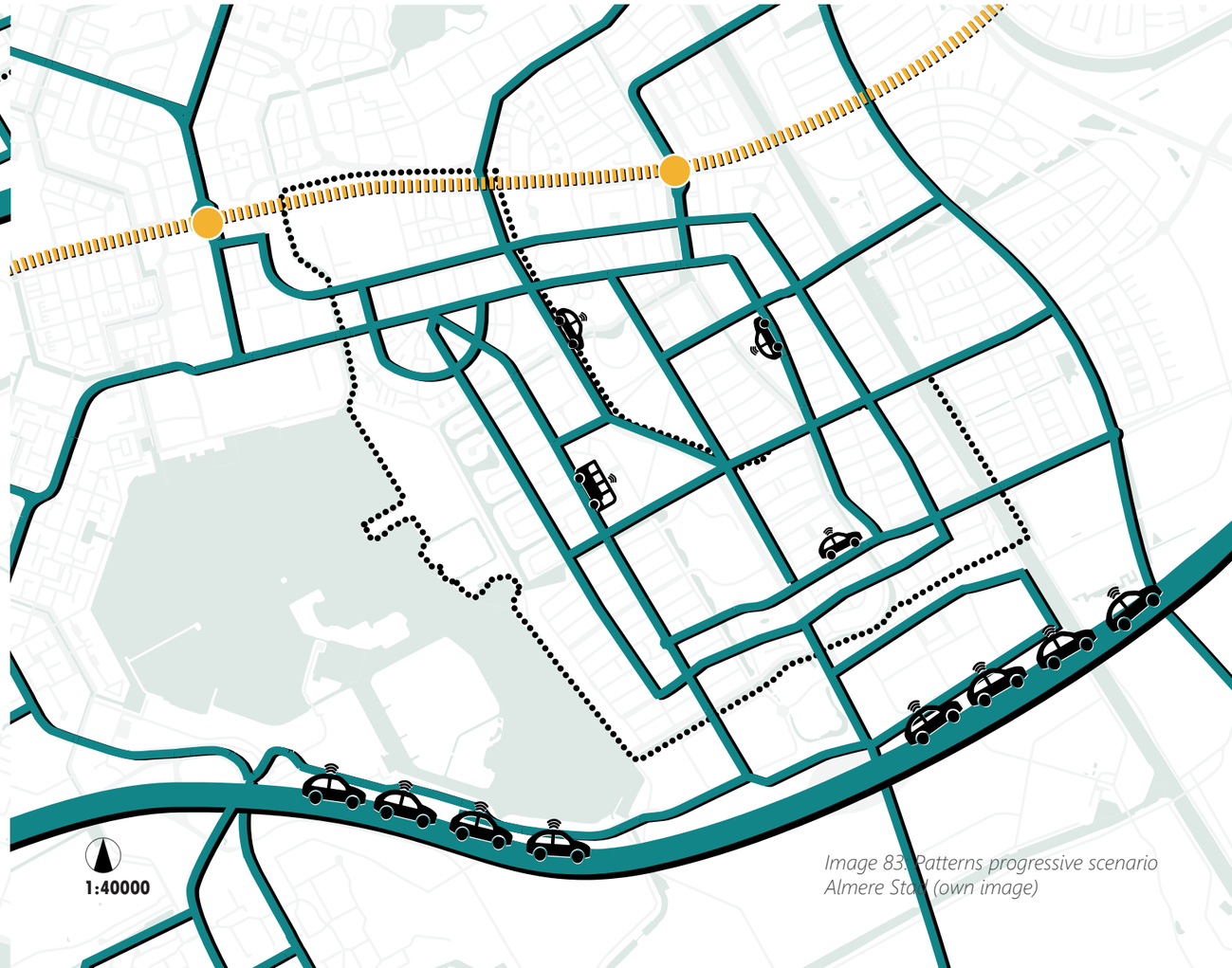


Image 83: Patterns progressive scenario Almere Stad (own image)



Image 84: Future streets? (Clares, 2015)

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DESIGN

Role of design

In this project the design plays an advisory role. It is used as tool to test all the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods recommendations will be made to guide planners and designers in designing healthy neighbourhoods for a future with automated mobility. At the end of this chapter a number of design elements are listed. There will be a reflection on what mutual relations there are, what the remarks are, which elements are depending on each other, etc. Also looking back at the existing structures, the design elements are coupled with the ambitions. All of this is used to fuel the recommendations.
Yet, the design is used as advisory tool. But a integral design is made where all elements regarding typologies, measurements, ecology, economy, etc. are all put together. This resulted in a design on the city scale, the district scale, and the neighbourhood scale. On the neighbourhood scale for each district an area is selected and this resulted in two main maps for these areas. Some sections and impressions are provided to get an idea of a possible design for the areas. The design will be addressed in the first part of this chapter.

Concluding , the design in this project is used as tool to form the recommendations which will reflect on the existing content and structure of the project.

Ambitions

In this paragraph the healthy neighbourhood building blocks are repeated. These form the ambitions to improve urban health in the residential neighbourhoods.

> 1
The healthy neighbourhood gives ample space to the slow traffic (cyclist and pedestrian), and the fast traffic will not be dominant.

In a lively and attractive city - a city with a high density - people like to go outside. They walk or cycle to go to work, the shops, school or the café. That is why we aim for neighbourhoods with a mixed facility pattern so that facilities are easily accessible on foot and by bicycle (Gemeente Amsterdam, n.d.-b). The urban design at micro scale is critical to a good walking and cycling environment, an environment which will activate people (NYC, 2010).

Slow traffic will not be obstructed by the fast mobility forms. Fast forms of mobility will not dominate the streets anymore. Cars, buses, taxi's, etc. drive around slow traffic zones. Slow traffic will get the full priority which allows people to move and meet in a safe environment. When designing the public space and the routes through the city, the cyclist and the pedestrian are considered first.

> 2
The healthy neighbourhood triggers and invites to move and meet.

The neighbourhood design will influence activity patterns. The design determines how inhabitants use the city. This is done by designing a mixed, diverse and dense urban areas, which are walkable and cyclable, and have parks and public spaces for the people (NYC, 2010). The aim is to give priority to slow traffic and create an 'activity friendly and inviting' environment. In these environments activity is a natural part of everyday life. Establishing the relationship between the physical layout of the city and the (un)conscious choice of people to move actively, knowing that moving is not as easy for every resident. Doing this, people are challenged to move more, meet more people in an informal way and services are more accessible for a wider audience (Gemeente Amsterdam, n.d.-a).

> 3
The healthy neighbourhood is a sport- and playground.

For children, adults and elderly, the city, the streets, the parks, the squares and the water trigger to play and exercise. In order to play you need to feel safe, you need space and the environment needs to stimulate you to come up with a game yourself. Not only there is a sufficient opportunity to move in neighbourhoods, the quality of public space is also crucial. Green plays a major role in this. Green areas should be in the right place, well accessible, safe and well integrated in the neighbourhood. Green spaces do not have to be big. Small, clear places are just as nice. The design of the public space triggers people to play a game of football, a walk with the dog or play hide and seek, etc. Sporting and playing locations are in the right place close to the target group, visible, inviting and triggering (Gemeente Amsterdam, n.d.-b).

> 4
The healthy neighbourhood comprises a healthy and clean environment, it is sustainable, resilient and climate proof.

Climate change resulting in wetter and warmer winters and drier and hotter summers ask for designing in a more sustainable and climate proof way. Designing climate proof neighbourhoods requires managing urban green and blue infrastructure to anticipate on extremes to maintain a good ecosystems. Improving ecosystems will be beneficial for the health of the community but also support the flora and fauna (GroenBlauwe Netwerken, n.d.).

> 5
The healthy neighbourhood is accessible and everyone is included.

In the development of urban areas a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018). This accessibility should mainly be focussing on the accessibility of these locations by active modes of travelling. Besides, the accessibility is also related to the people. All services should be accessible for everyone, and no one should be excluded.

Design city scale

The first part of the design chapter will elaborate on the design of the two selected neighbourhoods, starting on the city scale and zooming in later on.

The design of the two neighbourhoods will first be based on the progressive scenario, the stage in which automated mobility is fully embraced and integrated. With the information gained from this design could be stated which determinants and interventions should be deployed in the earlier scenarios. In the blue boxes the used scenario determinants and the design interventions gained from the theory are listed. In the second part of this chapter will be elaborated more on the recommendations derived from the design.

The map for the strategy of the city scale is shown on the next pages, image 87. The first step in building this map was understanding existing networks and new developments. The marked areas indicate where future development will take place. Besides, there are plans to extent the train line with a direct line towards Amsterdam and Utrecht. This is crucial information because we are working within the progressive scenario, which will take place in ± 40 years. By this time a large part or all of these projects are developed. This results in a change in mobility flows.

The second step includes overlaying the city with an AM network. Only bigger automated vehicles are allowed to drive on this network, but not on the roads/streets in between (except in exceptional cases). In these areas slow traffic gets the full priority. In these areas only small automated vehicles (pods), personal vehicles (-electric- bikes, scooters, etc.) and pedestrians are allowed. This design step is mainly based on the design intervention 'fast traffic around the neighbourhood' and 'car free zones'. And the scenario determinant 'allowing AM' and 'separation of flows'. The areas where big automated vehicles are not allowed and slow traffic gets the full priority are shown in the map of image 85.



Image 85: Slow traffic areas (own image)

The next step includes the highway entrances. The existing entrances are marked in green. However, to give the automated vehicles enough options to choose alternative roads when one route is to busy, missing entrances in the network will be added in this scenario. These new entrances are also needed to manage the introduced flows because of the new development. The introduced entrances are marked in blue.

The last layer of the map shows the central parking locations. In the progressive scenario automated vehicles are equipped and allowed to drive around without passengers and/or drivers. Automated vehicles can find their way independently. The car will pick you up, and you will be delivered to your destination. Afterwards it drives to a central parking area or is picking up or dropping of someone else (Kennisinstituut voor Mobiliteitsbeleid, 2015). The small blue dots indicate a network of central parking hubs were vehicles can be stalled when they are not driving. The areas around the parking hub might be excellent locations to create service and mobility (with different modalities) hubs where people can meet. This design step is based on the scenario determinant 'parking'.



Image 86: Interventions city scale (own image)

Progressive scenario - city scale

- Areas development
- AM highways
- AM lanes
- Entrance highway
- Entrance highway - new
- Parking hub - new
- Train lane
- New train lane
- Enhance green/blue infrastructures

1:75000

Image 87: Strategy Almere - progressive scenario (own image)

Design district scale

Zooming in to the district scale of Almere Haven (neighbourhoods: De Wierden, De Hoven, and De Werven) and Almere Stad (neighbourhoods: Filmwijk and Danswijk). The maps for the design strategy of the two districts can be found on the next pages, image 89 for Almere Haven, and image 90 for Almere Stad.

Again starting with the AM network. Only bigger automated vehicles are allowed to drive on this network, but not on the roads/ streets in between (except in exceptional cases like service provision). In these areas slow traffic gets the full priority. Here, only small automated vehicles, personal vehicles and pedestrians are allowed. This design step is mainly based on the design intervention 'fast traffic around the neighbourhood' and 'car free zones'. And the scenario determinant 'allowing AM'.

In between the mobility network, the green and blue infrastructures can be enhanced.

On top of the AM network the missing links are added. The missing links are connections which should be added to the main road network to complete the AM network. The completed network gives the vehicles possibilities to drive different routes. Because all vehicles communicate with each other, information on the crowdedness of routes will be shared constantly. If a road is to busy the automated vehicle will automatically drive another route, to prevent congestions. The missing links in the AM network are visualised by the dotted lines in the maps. Because Almere Stad had already a more fine meshed network, less missing links need to be added here.

Then, in the network there are certain roads which have a restriction. Due to the busy service along the roads the automated vehicles are not allowed to drive on these roads during certain hours. Resulting in safer situations around e.g. schools, during opening and closing times. This design step is mainly based on the design intervention 'safe crossings and routes'.

The next layer in the map indicates where kiss-and-ride points should occur. They are mainly located near main services but are also spread out over the neighbourhood. People have to walk, bike or use an personal vehicle to go to these specific points to get picked up by bigger automated vehicles. People switch here from the slow traffic network (local network) to the fast traffic network (supra-local network). This design step is based on the design intervention 'multi-modal nodes', and the scenario determinant 'separation of flows'.

The final layer are the parking hubs. The location of the parking hubs is most of the times near already existing services locations. The vehicles can be parked here when they are not driving around. The areas around the parking hub might be excellent locations to create service and mobility (with different modalities) hubs where people can meet. In the west side of Almere Haven are less parking hubs located. Here live more people with higher incomes who will probably have there own automated vehicle. Which will be parked on there own site as status symbol. This design step is based on the design interventions 'parking clustering' and 'multi-modal nodes', and the scenario determinants 'parking' and 'self driving unmanned'.



Image 88: Interventions district scale (own image)

Progressive scenario - district

- AM roads
- Missing links - AM roads
- Restric ted times - AM roads
- K+R Kiss and ride
- P Parking hubs
- Enhance green/blue infrastructures

1:20000

Image 89: Design Almere Haven - progressive scenario (own image)

Progressive scenario - district

- AM roads
- Missing links - AM roads
- Restric ted times - AM roads
- K+R Kiss and ride
- P Parking hubs
- Enhance green/blue infrastructures

1:20000

Image 90: Design Almere Stad - progressive scenario (own image)

Design neighbourhood scale

The introduction of automated vehicles gives the opportunity to unravel the existing mobility networks. In the design on this scale this is one of the main principles. Some roads will be cut off, some will be diverted and some will be connected. By disentangling the networks new spaces will be created. Spaces which can form community places in the neighbourhood. A space where people can come together without being interfered by fast mobility. Slow traffic routes will be created towards the community spaces. Meaning will be given to these spaces and routes.

The community spaces are in the two examples of Almere Haven and Almere Stad located around existing locations. The community space in Almere Haven (see image 94) is located around a school location. In the design for the progressive scenario some roads are cut off and others are added. Services and houses are added to the location. They are situated in and around a central square and park. Besides, a parking hub will be added to these locations, where vehicles which are not driving can be stalled. This is also the kiss-and-ride point for this community space.

Fitting with the character of the neighbourhood and the residents of the neighbourhood the newly designed area is focussing on recreation, playing and meeting. In this design a hierarchy of types of streets/ roads emerged (see image 91). The slow traffic routes which will lead to the community places are only meant for pedestrians and cyclists, see type 91.1. The other streets, which are no routes are for all slow traffic forms, from pedestrians, to small personal vehicles, to pods, see type 91.2. Exceptions are made for service provision of authorities. The fast traffic roads, see type 91.3, are for the fast automated vehicles. The fast and big autonomous vehicles are only allowed to drive on these roads. At crossings with type 91.1 or 91.2 the vehicles will stop autonomously for crossing with the slow traffic.

The community place in Almere Stad is situated around several services, see image 105. A school, community centre, a supermarket, and a child day-care centre. The neighbourhood has a more urban character with clear lines. This is translated into the design of the community place. The big square has a more urban character and is subdivided into different hybrid areas where different activities can take place. Also some amenities are added, such as an open air cinema, sport clubs, restaurants, shops and a parking hub. The design here in Almere Stad is tailored to the people living here, which are mostly families with children. The newly designed squares and streets put playing and sporting central.



Image 91: Road typologies (own image)

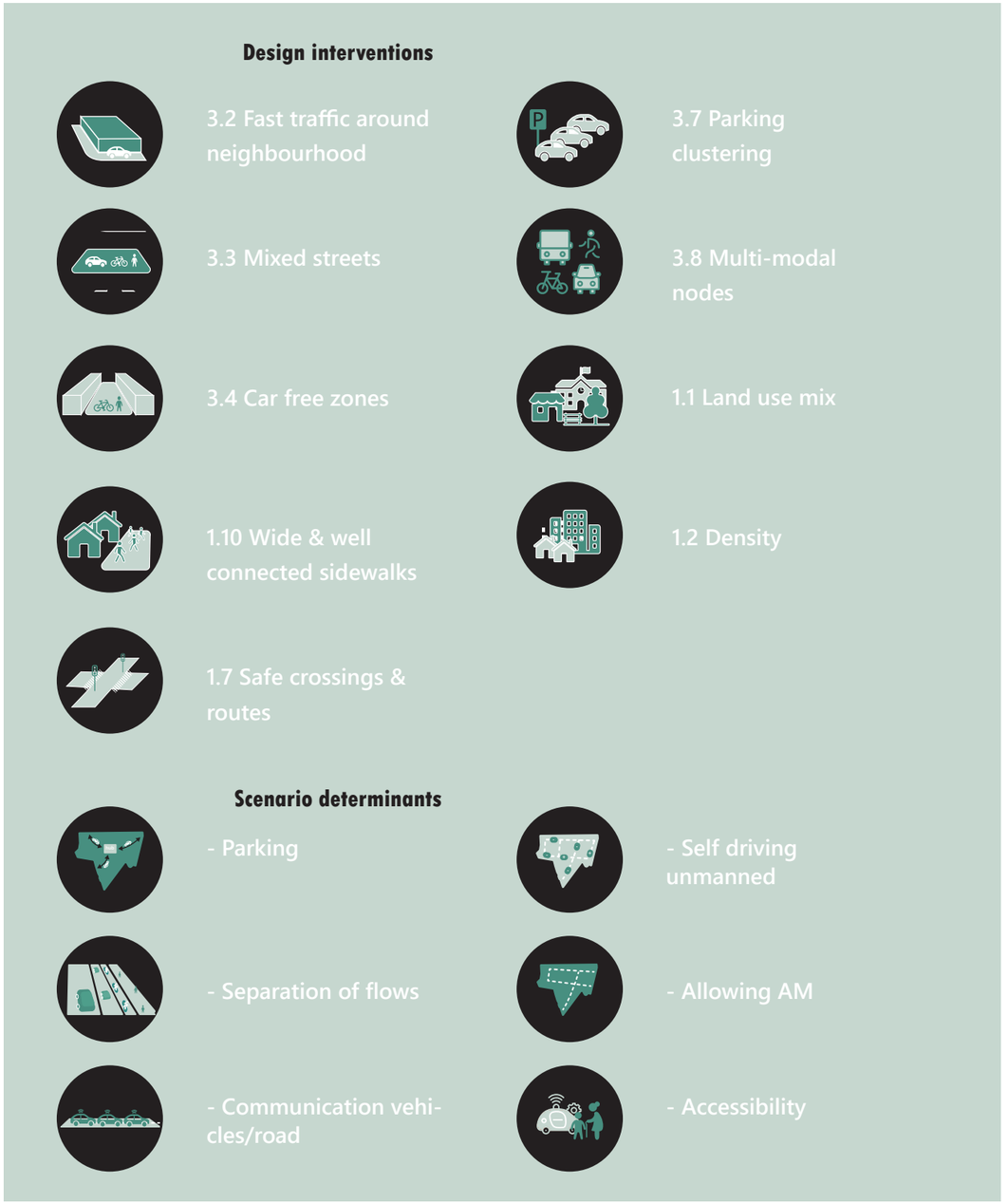


Image 92: Interventions neighbourhood scale (own image)

Design Almere Haven

Almere Haven - De Hoven/De Wierden
Map existing situation



Image 93: Existing map Almere Haven - progressive scenario (own image)

The current situation with a lot of spaces for mobility infrastructures. The slow traffic infrastructure is not connected everywhere.

Almere Haven - De Hoven/De Wierden
Map designed situation



Image 94: Design map Almere Haven - progressive scenario (own image)

The designed situation for the progressive scenario. On many roads fast vehicles are not allowed to drive anymore. Some fast traffic routes are cut off, and others are introduced.

PARKING HUB

SERVICES

HOUSES

PLAYING & MEETING

SPORT PARK

SCHOOL

GREEN & BLUE ROUTE

HOUSES

1:2500

PARK HIGHWAY


1. Archdaily, 2012


2. Groenblauwe netwerken, n.d.


3. Groenblauwe netwerken, n.d.


4. Architizer, 2009

Image 96: Reference images

PLAY & MEET


1. Archdaily, 2013


2. Archdaily, 2017


3. Green, 2013


4. Archdaily, 2015

Image 95: Reference images

Image 97: Design sketch-map Almere Haven - progressive scenario (own image)

Almere Haven - De Hoven/De Wierden (1:200)
Sections Keiwierde old (top) & new (bottom)

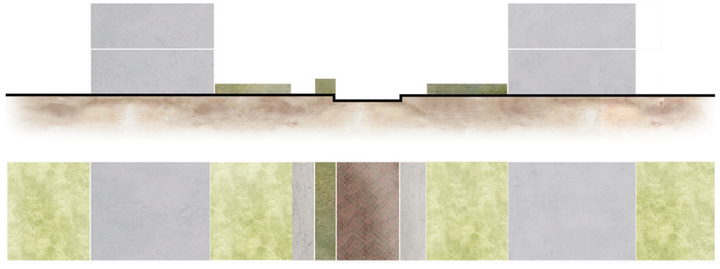


Image 98: Section Keiwierde - current situation (own image)



Image 100: Section Keiwierde - progressive scenario (own image)

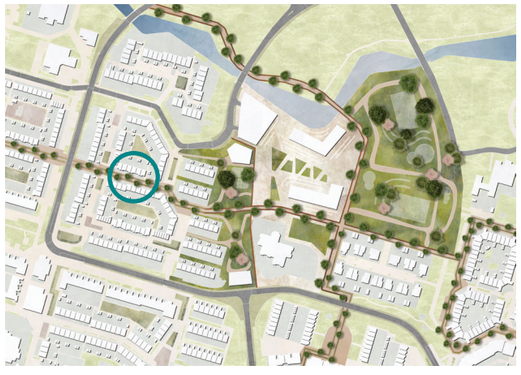


Image 99: Location section Keiwierde(own image)

Street design Almere Haven
In the design of the streets a few main elements are taken into account. These elements are derived from the healthy neighbourhood building blocks and the design qualities and interventions. First, the streets should be safe for slow traffic and this will be realised by banning fast traffic. Then, the streets should give some enclosure and bring back the human scale, so people feel at home and safe in the street. Besides, the street should provide places to socialise, play and sport and support someone's imageability. Therefore, there is not always chosen for straight forward street elements, but for abstract elements which can be used for different types of activities. Giving the people the freedom to use their imagination. Then, green infrastructure should be incorporated to fulfil ecology, health and sustainability goals. Also, the streets should reach a certain complexity to provide visual richness to a place. However, the streets should also be transparent, mainly because these streets are routes. Therefore, it is important to find a base profile for the street so that it is in each street clear that this is the main route.

In the design of the route towards the community places it was sought to design a base design for the street. This base profile becomes the most visible in image 100. It exist of two transit zones on the outside, along the front gardens. Then there are two green zones next to the transit zones. Finally in the middle there is a free zone. This free zone can be filled in or organised in different ways for the different streets. The free zones are filled in according to the needs or desires for the area. For example it can exist of playing elements, wadi's, water squares, etc. If the route is located in or along the concentration

Almere Haven - De Hoven/De Wierden (1:200)
Sections Uithof old (top) & new (bottom)

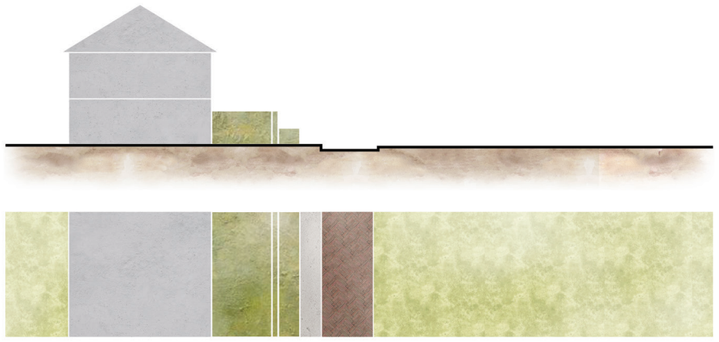


Image 101: Section Uithof - current situation (own image)

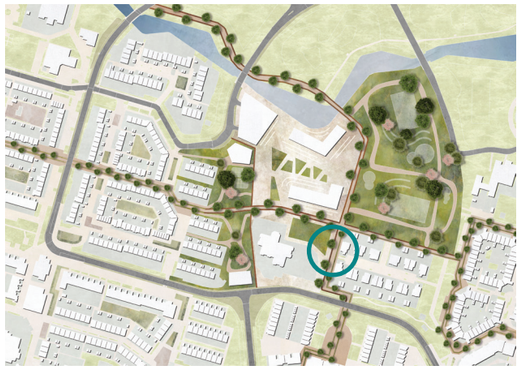


Image 102: Location section Uithof (own image)



Image 103: Section Uithof - progressive scenario (own image)

place one or two of the transition zones will be removed.

The zones will be separated by gutters (see park highway on image 96). These gutters can transport or drain water when there is for example heavy rainfall. Incorporating the gutters into the design of the street makes people aware of the water systems. Besides the transit zones are executed in half open materialisation. This means that when there is heavy rainfall, water can more easily be absorbed. On top of this (half) open surfaces will reduce the urban heat island effect. Where possible materials which are used in the streets will be reused again.

In Almere Haven the design of the community places and the routes towards it are focussing on the themes recreation, playing and meeting. This because on the one hand the locations are situated near a few school locations. The routes towards the school should be playful. Besides, there live a lot of elderly in this area. Places where they can meet informally and stroll easily are important aspects in the design for this area.

The section of image 100, de Keiwierde, is located between two school locations. This street will be mainly about playing and meeting. Street elements will give people and children the possibility to use it for different activities. It is a trigger to play and/or sport but also leaves room for someone's imagination.

The section of image 103, de Uithof, is located along the concentration place and is therefore somewhat smaller. The route focuses mainly as a green/blue route towards the park. It connect green/blue areas on a larger scale.

Almere Haven - De Hoven/De Wierden
Impression Keiwierde



Image 104: Impression Keiwierde - progressive scenario (own image)

The Keiwierde has a relatively small street profile. The route is marked by small elements, which can be used in multiple ways. The trees chosen are Acer Campestre because of its hight (6-10 m) and crown (egg-shaped). This gives the street some enclosure but also marks the route.



Image 105: Current situation (own image)

Almere Haven - De Hoven/De Wierden
Impression Montessoripad



Image 106: Impression Montessoripad - progressive scenario (own image)

In the community area around the primary school a few different routes come together from different directions. Also, some new services and facilities (like houses, retail, sport places, restaurants, etc.) are added to create a vibrant area, where people like to go.



Image 107: Current situation (own image)

Design Almere Stad

Almere Stad - Filmwijk
Map existing situation



Image 108: Existing map Almere Stad - progressive scenario (own image)

The current situation with a lot of spaces for mobility infrastructures. Large street profiles which are functioning as 'transport' zones and not as 'staying' zones.

Almere Stad - Filmwijk
Map designed situation



Image 109: Design map Almere Stad - progressive scenario (own image)

The designed situation for the progressive scenario. On many roads fast vehicles are not allowed to drive anymore. Some fast traffic routes are cut off. Different types of public spaces are introduced.

SPORT & PLAY


1. Archdaily, 2012


2. Groenblauwe netwerken, n.d.


3. Groenblauwe netwerken, n.d.


4. Archdaily, 2016

Image 110: Reference images

WATERFRONT


1. Archdaily, 2017


2. Archdaily, 2015


3.Archdaily, 2015


4. Green, 2014

Image 111: Reference images

GREEN & BLUE


1. Groenblauwe netwerken, n.d.


2. Claude Cormier + associés, 2018


3. Groenblauwe netwerken, n.d.


4. Groenblauwe netwerken, n.d.

Image 112: Reference images

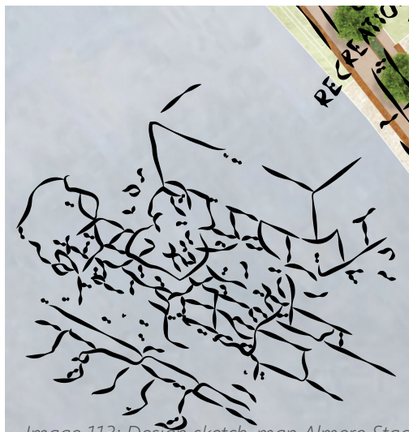


Image 113: Design sketch-map Almere Stad - progressive scenario (own image)

1:2500

Almere Stad - Filmwijk (1:200)
Sections Joris Ivenslaan old (top) & new (bottom)

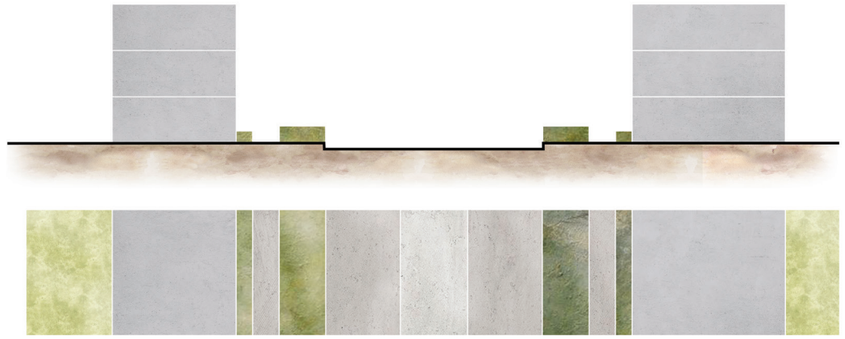


Image 114: Section Joris Ivenslaan - current situation (own image)



Image 115: Location section Joris Ivenslaan (own image)



Image 119: Section Joris Ivenslaan - progressive scenario (own image)

Street design Almere Stad
In Almere Stad live a lot of families with children. The space gained from disentangling the networks provides the opportunity to give new meaning to the places. In the new designs for the public spaces the themes sporting and playing are central. This will be aligned with the services provided in this area. The base street profile is also used in this areas and filled in with different functions, like sporting tracks, playgrounds, and wadi's.

In the example of Joris Ivenslaan (image 119) the free-zone is filled in with a water-square. During heavy rainfalls water can be temporarily stored here. During dry periods these squares function as sport and play areas. In different areas someone can undertake different activities.

Also considering water management, in this profile the same gutters as in Almere Haven are applied. These gutters can transport or drain water when there is for example heavy rainfall. Incorporating water elements like the gutters, water-squares and wadi's into the design of the street makes people aware of the water systems. Besides the transit zones are executed in half open materialisation. This means that when there is heavy rainfall, water can more easily be absorbed. On top of this, (half) open surfaces will reduce the urban heat island effect.

In the progressive scenario the role of shops changed completely. In shops it is more about creating experiences and giving advice to the people. A shop is about providing services which can not be given online, where most of the daily shopping will occur. The supermarket located in this area will be more

Almere Stad - Filmwijk (1:200)
Sections Fongerspad old (top) & new (bottom)

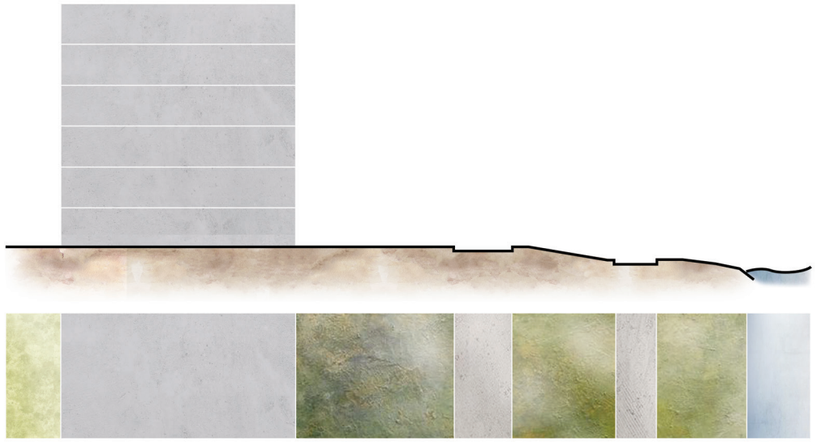


Image 120: Section Fongerspad - current situation (own image)



Image 121: Location section Fongerspad (own image)

about giving people advise about healthy food and lifestyle by giving workshops, consultations, and exercises Therefore, the hybrid area around the super market can be used for different activities like food workshops and markets.

Besides, new services will be added to this area which are focussing on healthy lifestyles. These are services like sport clubs and healthy food bars. The public space is inviting to sport or to play for both young and old. Hybrid public areas provide the opportunity to organise different activities, like an open air cinema, bootcamps, markets, etc.

Along the lake, the Fongerspad (see image 122) will be more focusing on recreation and recreation. The street profile will give the opportunity to be used for different activities like running, strolling and playing. The base profile is also used in this section, but is set up bigger and with other proportions.



Image 122: Section Fongerspad - progressive scenario (own image)

Almere Stad - Filmwijk
Impression Joris Ivenslaan



Image 123: Impression Joris Ivenslaan - progressive scenario (own image)

The Joris Ivenslaan has a relatively broad street profile. Therefore, big elements can be introduced like the water square, where people can stay for a longer period of time. Because of its dimensions, also bigger trees are selected, namely the Acer Plantancides (10-15 m). This gives the street a more monumental appearance.



Image 124: Current situation (own image)

Almere Stad - Filmwijk
Impression Walt Disneyplantsoen



Image 125: Impression Walt Disneyplantsoen - progressive scenario (own image)

In the community area around the primary school community spaces are created. There are a few areas created where people can come together in an informal way. There is also room for community activities which will enhance the social cohesion in the neighbourhood.



Image 126: Current situation (own image)

Economic structures

Realising the project can not be done at once. Especially, since expenses cannot be incurred in one go. Therefore this chapter provides a couple of methods in realising parts of the proposed design.

First, parts of the design, mainly of streets but also public spaces can be realised when major maintenance will be done. For example, when the sewage system needs to be replaced/maintained new opportunities arise to reconstruct the street profile. In this way, step by step, the areas can be regenerated. Further research should be done to coordinate the realization of the project and the planning of the municipality. This can be done throughout the hole city.

Also, inhabitants should be incorporated in the spatial interpretation of the design, and mainly the free zones. This creates streets which fit the inhabitants living there, their opinion is very important.

Besides, former public spaces can be 'given' to the inhabitants. A lot of parking lots will be abolished. When giving these parking lots to the inhabitants, the municipality does not need to take care of these spaces anymore. The people are responsible for the maintenance. Rules should be set up to give the people some guidelines in filling in their area. There areas can be carried out in extended front gardens or small areas in the public space (see image 127).

Another methods is giving the inhabitants of the neighbourhood the opportunity to create places themselves. This can be done in a simple way by closing down streets for cars, by for example placing some plant pots (see image 128). People can arrange the areas with furniture, plants- and flowerpots. Little community spaces can arise. This can be facilitated by policies which regulate the traffic program. Policies can regard the allowance of automated vehicles in the neighbourhood.

In addition the tax structures in a service economy driven society will probably change. Nowadays people pay vehicle tax to the governance if they own a vehicle. In the future less people will own vehicles (and other products) and our society will be based on services. It is conceivable that the private sector, who exploit the vehicle services, will pay the government for using the infrastructure. New forces enter the market, which might mean that more money will be demanded. This could result in more money for municipalities to spend. But this is only speculation.

Finally, nowadays in new development projects the developer is often obliged to invest in the public space. Now, the largest part of this project focuses on regeneration of existing neighbourhoods. However there are some new developments integrated, mainly in and around the community places. Here parking hubs, apartment and services will developed. The developers of these buildings should also invest in the public spaces around these buildings. With this, parts of the proposed design can be realised.



Image 127: Parking spaces for inhabitants (own image)



Image 128: Closed off street (own image)

Conservative & realistic scenario

Theory
The scheme of image 72 (on page 116) elaborated on how to tackle the existing and occurring problems (due to the introduction of AM) in mobility, and how to achieve the healthy neighbourhood ambitions. It uses design interventions and scenario determinants which can be used in the design of an urban environment. The scheme in image 115 elaborates theoretically on which design interventions and scenario determinants should be deployed and when, based on the design for the progressive scenario. In this scheme the interventions which can already be deployed in the conservative scenario are listed, they will be carried out in the other scenario, including some new ones, and removing some others which are not needed in an later scenario. Retroactively the scenario determinants will be deployed in a later stage, because only then automated mobility is fully integrated and the technology is developed. However, it is needed to already steer some design interventions into the right direction, by means of for example policies, to come to a favourable result in the end.

Now this matrix combines the interventions from the theory, which are used as base for the design, with the scenarios. However, it is still not totally clear what needs to be done for designing a healthy neighbourhood. Therefore, the second part of this chapter is focussing on unravelling the created design for the neighbourhoods. Unravelling the essentials will lead to clear and distinct design elements and recommendations. These can be the guidelines for urban planners and designers in achieve the ambitions in creating healthy neighbourhoods.

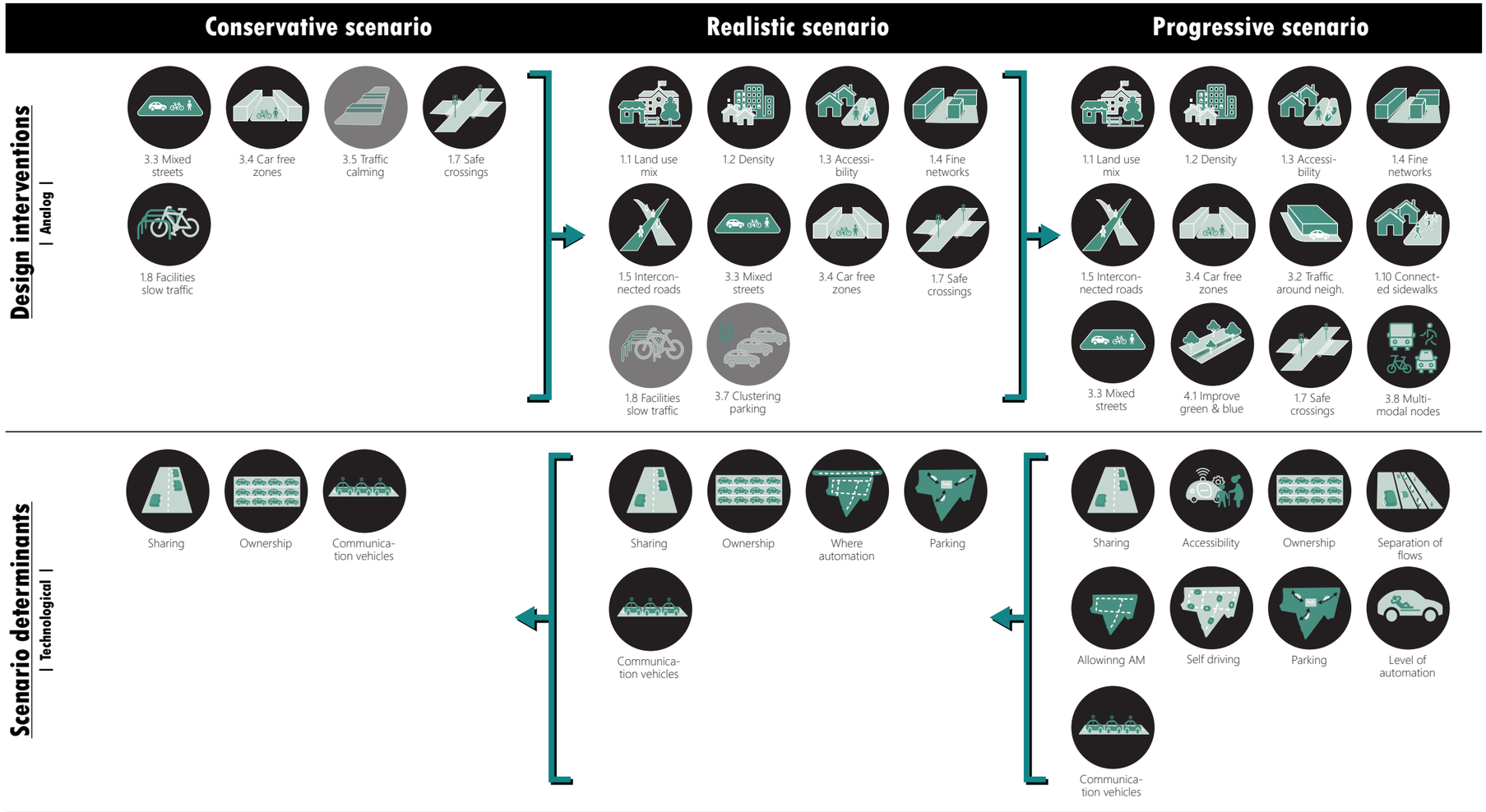


Image 129: Matrix design interventions & scenario determinants (own image)

Reflection - design elements

From the design, shown in the previous paragraphs, clear design steps will be unravelled in this paragraph. In the scheme below, on three main scales (city, district, neighbourhood), is described what is needed to do to create a healthy neighbourhood in a future with automated mobility. The listed design elements are both derived from the theoretical framework of design interventions and scenario determinants. And from tests in the design of the two neighbourhoods. The third column will describe the design elements more in detail. The next column will show a small principle drawing of each element (for the district and neighbourhood scale Almere Haven is taken as example). Then in the fifth column is mentioned to which ambitions the design elements are contributing (the ambitions are described in the paragraph Ambitions earlier in this chapter). In the last column is marked what the relations of the design elements are with other design elements or other elements. There are four main relations.

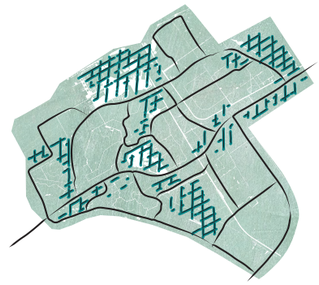
First, some of the design elements are depending on other design elements or development. Others are mutually linked or are linked with other design elements. Also some have a certain remark, this is mainly regarding existing or new development. Finally the design element which are mainly stimulating and facilitating physical activity are also marked. These design elements support the walkability and cyclability of the neighbourhood.

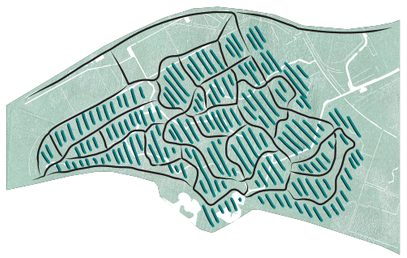
Relations design elements

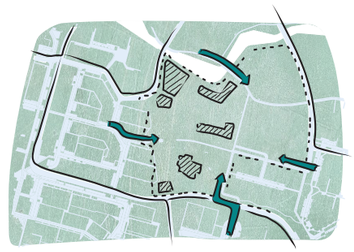
- Depending on
- Linked
- Remark
- PA — Stimulating and facilitating physical activity

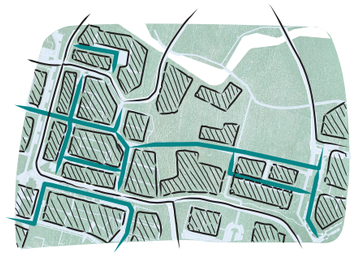
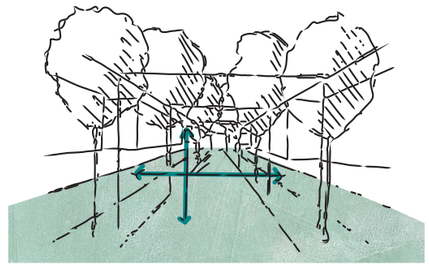
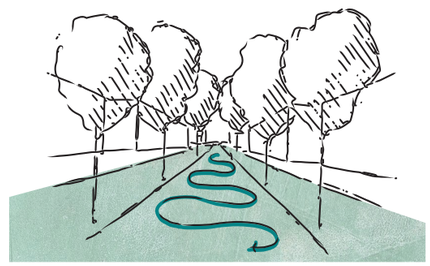
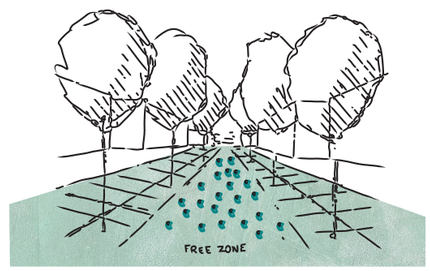
Design elements

- • Derived from analogue interventions
- \+ Derived from technological interventions

Scale	Design elements	Explanation		Principle drawing	Ambition	Relations
> City scale	• **1.1** - Mobility network	Fast traffic will be guided around the neighbourhood - in the neighbourhood slow traffic gets the full priority			**1**	*driving independent & allowing AM*
	• **1.2** - Green/blue infrastructures	Improve green and blue infrastructures to meet sustainability, health and ecology goals			**4**	*mobility network*

Scale	Design elements	Explanation		Principle drawing	Ambition	Relations
	+ 1.3 - Separation of flows	On fast traffic routes traffic flows will be separated to ensure the continuity of the flows. On slow traffic routes, where slow traffic forms will get the priority, the streets will be more mixed. Mixing and more self-regulation increases alertness and road safety.			**1**	*allowing AM*
	+ 1.4 - Allowing automated mobility	Automated mobility will be allowed on a limited number of roads. In this way the inside areas can be green, walkable and cyclable.			**1**	*mobility network*
	• **1.5** - Density	A high concentration of facilities and houses makes it easier to walk or cycle from A to B.			**2**	* *not applicable in all situation* PA *destinations are nearby*
	• **1.6** - Diversity	Diversity reflects the variety of land use in an urban area - in an area with a high diversity destinations are easier approachable by active transport.			**2**	* *not applicable in all situation* PA *destinations are nearby*
> District scale	• **2.1** - Fast vehicle free zones	In the spaces in between the fast traffic infrastructures slow traffic gets the full priority - fast vehicles are not allowed here.			**1 - 2**	*allowing AM*

Scale	Design elements	Explanation		Principle drawing	Ambition	Relations
	+ 2.2 - Driving independent	Automated vehicles can now find their way independently. The car will pick you up, and you will be delivered to your destination. Afterwards it drives to a central parking area or is picking up or dropping of someone else.			**1**	*development technolgies*
	•/+ 2.3 - Parking	Automated vehicles will be parked in parking hubs which are located throughout the neighbourhood - vehicles do not needed to be parked in the streets anymore.			**1**	*driving indepentent*
	• 2.4 - Places to meet, play & sport	Areas where people can meet, play and sport without being interfered by fast traffic.			**2 - 3**	PA *walkable and cyclable routes*
	• 2.5 - Interconnected roads & routes	Providing interconnected routes for slow traffic between a network of concentration spaces in the neighbourhood.			**1 - 5**	
> Neighbourhood scale	**• 3.1** - Public areas / buildings accessibility	All public areas and buildings should be easily accessible for everyone by active transport.			**5**	PA *accessible locations active travels*

Scale	Design elements	Explanation		Principle drawing	Ambition	Relations
	• **3.2** - Safety	Streets should be safe for slow traffic and this will be realised by banning fast traffic.			**2**	PA *physically safe routes* *allowing AM*
	• **3.3** - Human scale / enclosure	The streets should give some enclosure and bring back the human scale, so people feel at home and safe in the street.			**2**	PA *sense of safety* *mutual*
	• **3.4** - Complexity / transparency	The streets should reach a certain complexity to provide visual richness to a place. However, the streets should also be transparent, mainly because these streets are routes.			**2**	PA *visual richness & clarity* *mutual*
	• **3.5** - Elements to meet, play & sport / imageability	The street should provide places to socialise, play and sport and support/ triggers someone's imageability. This is a quality of a place that makes it distinct, recognizable, and memorable			**2 - 3**	PA *triggers imagination* *mutual*
	• **3.6** - Include local inhabitants in design and maintenance	Including local inhabitants in the design of the free zones will connect them more to the space and will make them feel more responsible and they are more likely to use it. Besides, a lot of parking lots will be abolished, those can be given to the inhabitants. The people are responsible for the maintenance.			**5**	

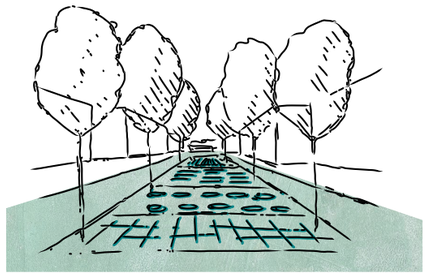
Scale	Design elements	Explanation		Principle drawing	Ambition	Relations
	• **3.7** - Encourage community activities	Encouraging community activities/responsibilities will strengthen a community - people are more likely to know and trust their neighbours.			**5**	
	• **3.8** - Sustainable design	Sustainability is one of the main goals in creating a healthy neighbourhoods so this needs to be incorporated in the detailed design and the materialisation.			**4**	

Image 130: Unravel design - design elements (own image)

Conclusions
The design elements on the city scale are focussing on bigger networks. The introduction of automated vehicles provides the opportunity to unravel the existing mobility networks. Fast mobility will be guided around the neighbourhood. In the spaces in between slow traffic gets the full priority. Also some new spaces can be created for the community because fast mobility networks are rearranged and many are cut off. This design element is depending on the development in driving independently and the allowance of the automated vehicles in the city. Autonomous vehicles should be allowed only on a limited number of roads.

By the rearrangement of the mobility networks not only slow traffic will get more space, there is also room for strengthening the green and blue infrastructures. Gained spaces can be used to provide and re-link green and blue routes to strengthen the ecology of the area.

Throughout the city there will be new mobility networks and also new hierarchies. On fast traffic routes traffic flows will be separated to ensure the continuity of the flows. On slow traffic routes, where slow traffic forms will get the priority, the streets will be more mixed. Mixing and more self-regulation increases alertness and road safety. This design element is linked to allowing automated mobility.

In an area with a high diversity and density, destinations are easier approachable for active transport. However, density and diversity are hard to achieve in already existing urban areas. Since this project is dealing with existing neighbourhoods these two design elements are less implemented.

On the district scale vehicles will be parked in parking hubs. A network of parking hubs should be provided to store all the vehicles. By doing this vehicles do not need to be parked in the streets anymore. This design element is highly dependent on the technology of independently self driving cars. If vehicles cannot drive independent the network of parking areas should be more fine meshed, and vehicles will probably still be parking in the streets.

Also on the district scale the network of slow traffic routes should be strengthened. By disentangling the fast mobility networks new community places will arise. These should be connected by strong routes, creating a network of meeting places. The routes and meeting places can give meaning to the neighbourhood.

On the neighbourhood scale, these community places should be easily accessible by active transport. The main focus in the design on the block scale is creating areas and routes which are accessible for slow traffic and will stimulate activity (physical and social).

This can be achieved by creating safe streets for slow traffic and this will be realised by banning fast traffic. Then, the streets should give some enclosure and bring back the human scale, so people feel at home and safe in the street. Besides, the street should provide places to socialise, play and sport and support someone's imageability. Therefore, there is not always chosen for straight forward street elements, but for abstract elements which can be used for different types of activities. Giving the people the freedom to use their imagination. Also, the streets should reach a certain complexity to provide visual richness to a place. However, the streets should also be transparent, mainly because these streets are routes. It was important to find a base profile for the street so that it is in each street clear that this is the main route.

Finally to trigger people to go outside inhabitants should be included. Included in, for example, the design of the free zones in the streets. But also giving them responsibility over an area will bring more people together.

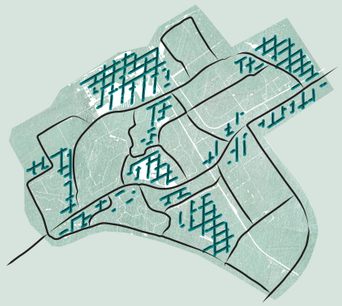
On the following pages the unravelled design elements are linked to the design made in the first part of the chapter. This is done in groups of design elements which are expressed the most in the specific design drawing/map.

Almere Haven



• 1.1 Mobility network

Ambitions
> 1: Slow traffic priority



• 1.2 Green/blue infrastructures

Ambitions
> 4: Healthy & clean environment



+ 1.3 Separation of flows

Ambitions
> 1: Slow traffic priority



+ 1.4 Allowing automated mobility

Ambitions
> 1: Slow traffic priority

Image 131: Almere Haven (own image)

1.4 Allowing AM

Big automated vehicles are only on a limited number of roads. Small automated vehicles are allowed on more roads

1.3 Separation of flows

On fast traffic routes traffic flows will be separated. On slow traffic routes, the flows will be more mixed



1.2 Green/blue infrastructure

In highlighted zones green and blue infrastructures will be realised/enhanced. A structure within the mobility network

1.1 Mobility network

A selection of roads will from the mobility network. Automated vehicles will drive on this network

Almere Stad



• 2.1 Fast vehicle free zones

Ambitions
> 1: Slow traffic priority
> 2: Invites to move and meet



+ 2.2 Driving independent

Ambitions
> 1: Slow traffic priority



•/+ 2.3 Parking clustered

Ambitions
> 1: Slow traffic priority

Image 132: Almere Stad (own image)

2.2 Driving independent

Vehicles will drive autonomously on the mobility networks between parking hubs and kiss and ride points



2.1 Fast vehicle free zones

In the neighbourhoods blocks big automated vehicles are not allowed. There are a lot of safe spaces for the pedestrian and cyclist

2.3 Parking clustered

Automated vehicles will be stalled in parking hubs. People will go to the parking hub or kiss and ride point to use the fast traffic network

De Wierden/De Hoven - Almere Haven



• 2.4 Places to meet, play & sport

Ambitions
> 2: Invites to move and meet
> 3: Sport- & playground



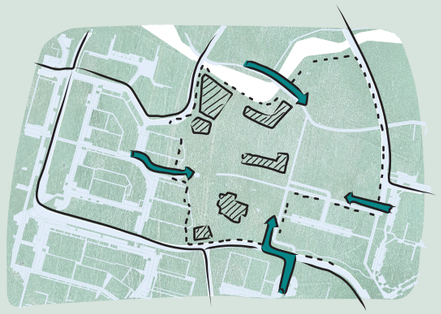
• 2.5 Interconnected roads & routes

Ambitions
> 1: Slow traffic priority
> 5: Accessibility



Image 133: De Wierden/De Hoven - Almere Haven (own image)

Uithof/Montessoripad - Almere Haven



• 3.1 Public areas / buildings accessibility

Ambitions
> 5: Accessibility



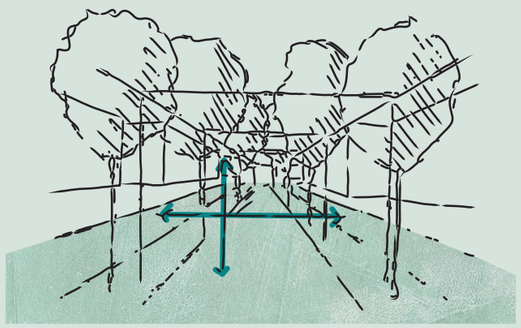
• 3.2 Safety

Ambitions
> 2: Invites to move and meet



Image 134: Uithof/Montessoripad -- Almere Haven (own image)

Joris Ivenslaan - Almere Stad



• 3.3 Human scale / enclosure

Ambitions
> 2: Invites to move and meet



• 3.4 Complexity / transparency

Ambitions
> 2: Invites to move and meet



• 3.5 Elements to meet, play & sport / imageability

Ambitions
> 2: Invites to move and meet
> 3: Sport- & playground

Image 135: Joris Ivenslaan - Almere Stad (own image)

3.4 Complexity / transparency

Streets should reach a certain complexity to create visual richness. However to orientate, they also need to be transparent so people can reach their destination

2.1



3.3 Human scale / enclosure

Human scale and enclosure gives people the sense of being safe and feeling at home in a street. This can be provided by selecting the right trees for each street. In this case the trees are the Acer Plant-ancides

3.5 Elements / imageability

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3.8

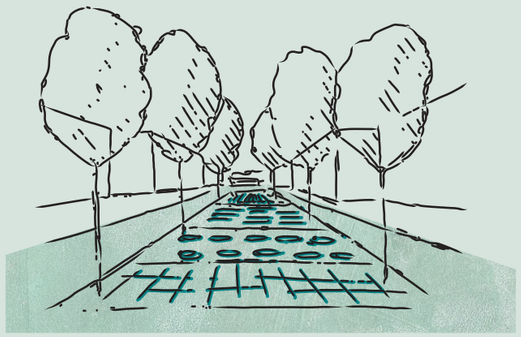
3.6

Walt Disneyplantsoen - Almere Stad



• 3.6 Include local inhabitants

Ambitions
> 5: Accessibility



• 3.7 Encourage community activities

Ambitions
> 5: Accessibility



• 3.8 Sustainabile design

Ambitions
> 4: Healthy & clean environment

Image 136: Walt Disneyplantsoen - Almere Stad (own image)

3.3

3.6 Include local inhabitants

Including local inhabitants in the design and maintenance of zones will connect them more to the space and make them feel more responsible

3.3



2.1

3.7 Encourage community activities

Encouraging community activities/responsibilities will strengthen a community - people are more likely to know and trust their neighbours.

3.2

3.8 Sustainable design

Sustainability is one of the main goals in creating a healthy neighbourhoods so this needs to be incorporated in the design and the materialisation

Recommendations - 3 steps

In this paragraph is described which three main steps should be done on the three scales to create healthy neighbourhoods in a future with automated mobility. These are the tree main actions required to meet the ambitions.

First on the city scale the fast traffic mobility network will be rearranged. Fast traffic will be guided around the neighbourhood, and in the neighbourhood slow traffic gets the full priority. This step is closely related to the design element allowing automated mobility. A limited allowance of automated mobility is needed as first step in creating healthy neighbourhoods. Rethinking the mobility networks gives opportunities to design for healthy neighbourhoods in terms of stimulating and facilitating physical activity and social cohesion. But it also gives opportunities to strengthen green and blue infrastructures to meet ecology and sustainability goals. The new mobility network will be connected to a network of parking hubs were vehicles can be stalled when they are not driving.

This step will mainly contribute to the ambitions 1, 4 , and 5. Those are about 'slow traffic priority', 'healthy & clean environment' and 'accessibility'.

Due to the new mobility networks a lot of car free zones arise. The disentanglement of the networks will result in new areas which can be used for the community. These community areas are connected with each other by strong slow traffic routes. This together will form a network of community spaces in the neighbourhood. The routes and meeting places can give meaning to the neighbourhood in different ways.

This step contribute to the following ambitions: 1, 2, 3, and 5. Those reflect 'slow traffic priority', 'invites to move and meet', 'sport- and playground' and 'accessibility'.

The main focus in the design on the neighbourhood scale is creating areas and routes which are accessible for slow traffic and will stimulate and facilitate activity (physical and social). This is not done by only one step, but consists of a few different factors which can be drivers for stimulating activity. These drivers are safety, human scale, enclosure, complexity, transparency, and imageability. These drivers can all be used in different urban environment to trigger and invite people to move and meet. They are critical to a good walking and cycling environment, an environment which will activate people (NYC, 2010).

This step will mainly contribute to the ambitions 2, 3, and 5. Which reflects 'invites to move and meet', 'sport- and playground' and 'accessibility'.

Promoting physical activity through urban design at the micro scale (neighbourhood scale) is one of the most effective measures to improve urban health. On top of this, strategies in reducing air pollution on the macro scale (city scale) will also be highly impactful in reducing diseases worsened by poor air quality. Besides, in the development of urban areas (on the district scale) a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018).

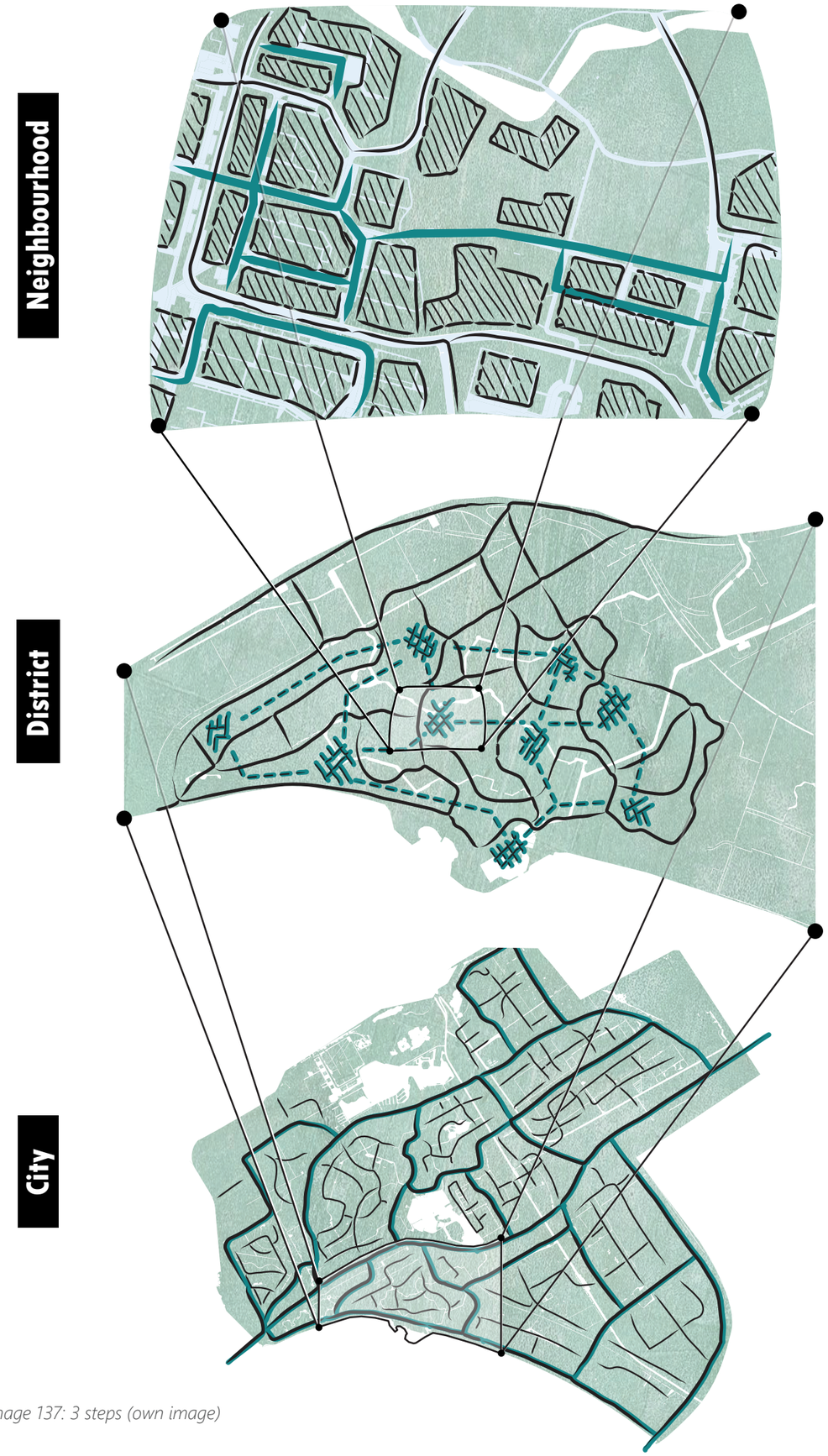


Image 137: 3 steps (own image)

Reflection - content & construction

Content
Besides the recommendations in favour of urban health, described in the previous chapter, there are also a few remarks. It is of great importance to pursue the design elements in such a way that they are not threatening the urban health.

The first situation which is not desirable in terms of promoting urban health is the unlimited allowance of vehicles in the city. If automated vehicles are allowed to drive everywhere the cars will still dominate the city. In fact, due to the growing mobility, more and more cars will drive through the streets, which leaves less space for the slow traffic. This is something which should be prevented.

Besides, an other undesirable situation is when all flows in the whole city will be separated to guarantee an continuous flow. This will lead to less permeable infrastructures. Slow traffic can only cross the fast traffic roads at specific points. The road networks becomes less accessible for the pedestrian and cyclist. Also, a situation which should be prevented.

Careful management is needed to steer these developments at an early stage, to come to a health stimulating environment in the future. Although the benefits of health promoting design tend to occur on the long term, in industrialised countries, it is important to steer and design already for a IT-driven future. Major expenses in health care in the future can be prevented in this way (Pineo & Rydin, 2018).

Construction
But besides the restrictions regarding the content of the recommendations, there are also some restrictions/flaws in the construction of the project.

The first one concerns the scenario construction. The whole design and therefore the ambitions and recommendations are based upon the progressive scenario. The scenario is based upon predictions and assumptions. However, it is uncertain what will happen on the long term. It is conceivable that the reality will differ from these predictions. Technology might not be as developed yet, or further developed than we can now think of. Another scenario will lead to another design and to other recommendations. However, scenario planning/designing is one of the only manners to deal with an unpredictable future.

Also, another flaw is that the ambitions, derived from the urban health goals, will differ per location. In other parts of the worlds we are dealing with other health problems. This will lead to other ambitions to stimulate urban health, resulting in different recommendations. Therefore, the recommendations count only for comparable situations in comparable economies (for example other post-war residential areas in The Netherlands).

Finally, urban planning and design plays a central role in securing conditions and addressing problems in the cities which will support health and well-being (Barton & Tsourou, 2000). Urban planners and designers do not only improve health but also have an affect on the wide-ranging social and economic infrastructures, which also affects health. Around 80% of the health of the community could be determined by urban planning, if considering the wider impact of urban planning programmes and policies (Pineo & Rydin, 2018). This being said public health is not only influenced by the built environment only, there are also other determinants like social relations, the condition of the house someone's living in, genetic predisposition of diseases, etc. Not all factors can be tackled by interventions in the built environment.

Prior & new steps

Previous scenarios
In the other two scenarios not all design elements can be implemented yet. Mainly because the technology of automated vehicles is not fully developed yet. Car cannot or are not allowed to drive fully autonomous or independent in these stages. But, there are a few design elements which can and should already start at an early stage. In terms of policies it is important to manage where automated vehicles are allowed to drive and where they should be parked. The other elements which can be implemented relate the more 'analogue' interventions which can be done in the built environment. There are for example 'places to meet/sport/play', 'interconnected routes & roads', 'fast vehicle free zones', and 'public area accessibility'.

Future development
All design elements and recommendations which are described in previous paragraphs are mainly set up for existing neighbourhood typologies. But, they can also be applied in new neighbourhoods. However, designing new neighbourhoods brings also some opportunities.

Designing from scratch gives possibility to have another starting position. Design elements which can be used as starting point in designing healthy neighbourhoods are for example diversity and density. Diversity reflects the variety of land use in an urban area. Density reflects the concentration of services and houses in an urban area. In an area with a high diversity and density destinations are easier approachable by active transport. The destination proximity can be taken into account in a design for a neighbourhood.

Designing dense and diverse neighbourhoods can be a good starting point. Afterwards, also the other design steps, as mentioned before, can be applied.

The design of the public spaces, including the drivers safety, human scale, enclosure, complexity, transparency, and imageability, can trigger and invite people to move and meet. They are critical to a good walking and cycling environment, an environment which will activate people. This combined with the density and diversity, can promote an active living through urban design and planning (NYC, 2010).

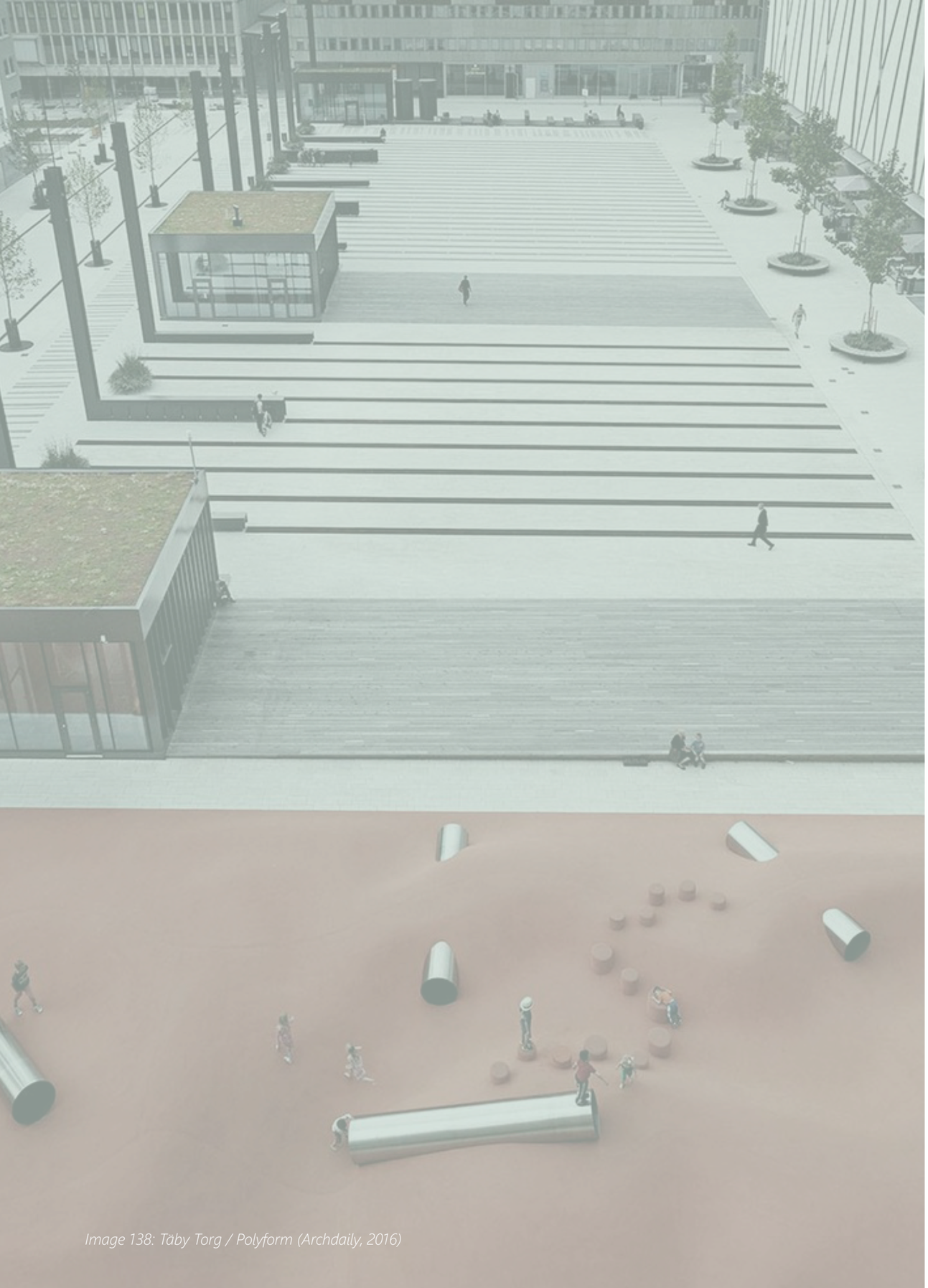


Image 138: Täby Torg / Polyform (Archdaily, 2016)

CONCLUSION

Conclusion

Problem field
Since the introduction of the car, our use of mobility is continuously growing (Kennisinstituut voor Mobiliteitsbeleid, 2018). Which leads to highly polluted areas, affecting urban health. Besides, the growing mobility results in a higher number of traffic accidents on the road networks (NU.nl, 2017).

But, not only growing mobility, but also the urban development of our cities will have an influence on urban health. Suburban development causes a population level reliance on car use every day. This imposed reliance causes low physical activity levels in a lot of residential neighbourhoods among many industrialized countries (Badland & Schofield, 2005). Physical inactivity, caused by dominance of the car in cities, the car dependency and infrastructural barriers in the city, can result in major health risks (Badland & Schofield, 2005).

The introduction of automated mobility will provide car users with new possibilities to do while traveling. As a consequence, people are willing to travel longer, and the frequency of trips might increase (Stead et al., 2018). This can lead to more urban sprawl and an even bigger reliance on the car.

Without management of the automated mobility, active travel and slow traffic accessibility will suffer, resulting in many health risks (Stead, 2018).

Problem statement
Summing up, the ever-growing mobility puts urban health at risk. On top of this, the introduction of automated mobility is posing a threat on various facets of urban health (personal lifestyles, accessibility, etc.), especially in residential neighbourhoods (because of the high car dependency).

The challenge is to improve urban health in residential neighbourhood while mobility is growing and automated mobility is introduced and poses a threat on urban health.

Context
Since the largest part of our society lives in residential neighbourhoods, and in these areas is a high car dependency, this project will focus on residential neighbourhood. For the scope of this project Almere is chosen as location, because this city is the embodiment of residential areas. In Almere Have the areas De Wierden, De Hoven and De Werven are selected. These areas are selected because they are more isolated from the rest of the city, and therefore the car dependency is higher. In Almere Stad, the areas Filmwijk and Danswijk are selected. These areas are selected because there are already a lot of cars in these neighbourhoods which result traffic issues.

Hypothesis
Where the rise of industry and mobility for the general public, in the nineteenth century, had a negative impact on the health of society (pollution, physical inactivity due to larger distances and convenience, infectious diseases, etc.), new technologies might be a catalyst for health.

A new chance? New technologies offer all kinds of opportunities in terms of participation, accessibility, space, environment and sustainability. Due to the introduction of automated mobility, with their additional opportunities, the car can fulfil a new role in the city.

In this project the hypothesis is: the implementation of automated mobility can contribute to improving urban health in residential neighbourhoods.

Aim
The aim is to improve urban health in residential neighbourhoods, by using automated mobility as catalyst. This is done by developing urban regeneration strategies with a set of design interventions and scenario determinants for the two specific existing residential neighbourhoods. Creating and retrofitting urban environments which will improve urban health. The design will be used in an advisory manner. It is used as tool to test the design interventions and scenario determinants gained from the theory. By testing these in the design of the two neighbourhoods, recommendations will be set up to guide planners and designers in designing healthy neighbourhoods in a future with automated mobility.

With the information from these tests in the design of the progressive scenario can be said which interventions should be made in earlier scenarios, and also what is needed for new neighbourhoods.

The following question is leading in this project:

"How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?"

Method
Since this project is concerned with the topic automated mobility and the impact of it on urban health, the research type is a predictive one. Automated mobility is still in an early stage, it is uncertain what will happen in the future. Therefore, scenario planning will be at the heart of this project. Scenario planning takes into account a range of possible futures which includes its uncertainties as a whole (Peterson et al., 2003).

Three main scenarios are developed within three time frames.

The conservative scenario will take place in the first time frame, approximately between 2020-2040. This stage is comparable to the situation where we live in now. Automated vehicles will gently enter the market, but they are hardly integrated.

The realistic scenario will take place in the second time frame, approximately between 2040-2060. In this stage there is an



Image 139: 3 scenarios (own image)

accumulation of different forms of traveling. All new forms and all traditional forms of traveling exist along each other. This results in a certain chaos in mobility. The end of this period will also be the tipping point for fully implementing and embracing of the autonomous vehicles.

The progressive scenario will take place the third time frame 2060>. In this stage the automated vehicles (level 5) will be fully implemented and embraced. All vehicles will be driving around autonomously, everywhere. The automated vehicles can drive around independently. Meaning that there is no driver required in the vehicle to move. The driver is now a passenger in the vehicle. A automated vehicle can pick you up, and you will be delivered to your destination. Afterwards it drives to a central parking area or is picking up or dropping of someone else. (Kennisinstituut voor Mobiliteitsbeleid, 2015).

The design of the two neighbourhoods will first be based on the progressive scenario, the stage in which automated mobility is fully embraced and integrated. With information gained from this design could be stated which determinants and interventions should be deployed in the earlier scenarios.

Urban health

This project explores the possibilities and opportunities of improving urban health with the introduction of automated mobility. Urban health will be improved in terms of improved air quality and noise reduction. However, due to automated mobility active forms of travelling are under threat, which puts urban health at risk (healthy lifestyles, accessibility, social cohesion). Focus in this project was going out to activity and mobility patterns of the inhabitants in neighbourhoods. Planning and designing healthy residential neighbourhoods, by e.g. stimulating and facilitating activity, opportunities will be created to improve urban health. Focussing on improving personal lifestyles, social cohesion, accessibility, in combination with the gained advantages of introducing automated mobility in terms of air quality and safety, healthier neighbourhoods can be created. In this, existing problems need to be taken into account as well.

A few ambitions are set up to make it more clear what design actions need to be made in the design for the progressive scenario. The ambitions are:

> 1
The healthy neighbourhood gives ample space to the slow traffic (cyclist and pedestrian), and the fast traffic will not be dominant.
> 2
The healthy neighbourhood triggers and invites to move and meet.
> 3
The healthy neighbourhood is a sport- and playground.
> 4
The healthy neighbourhood comprises a healthy and clean environment, it is sustainable, resilient and climate proof.
> 5
The healthy neighbourhood is accessible and everyone is included.

Design tests

Design interventions and scenario determinants are implemented in the design of Almere Haven and Almere Stad. Yet, the design is used as advisory tool. An integral design is



Image 140: Design Almere Haven (own image)



Image 141: Design Almere Stad (own image)

made where elements regarding typologies, measurements, ecology, economy, etc. are all put together. This resulted in a design on the city scale, the district scale, and the neighbourhood scale . On the neighbourhood scale for each district an area is selected and this resulted in two main integral maps for these areas (see image 140-141). Some sections and impressions are provided to get an idea of possible designs for the areas.

Unravel

From the design, shown in the previous paragraphs, clear design steps will be unravelled. Design elements on three main scales (city, neighbourhood, block) describe what is needed to create a healthy neighbourhood in a future with automated mobility. The listed design elements are both derived from the theoretical framework of design interventions and scenario determinants. And from tests in the design of the two neighbourhoods. Described below are the tree main actions required to meet the ambitions.

First on the city scale the fast traffic mobility network will be rearranged. Fast traffic will be guided around the neighbourhood, and in the neighbourhood slow traffic gets the full priority. This step is closely related to the design element allowing automated mobility. A limited allowance of automated mobility is needed as first step in creating healthy neighbourhoods. Rethinking the mobility networks gives opportunities to design for healthy neighbourhoods in terms of stimulating and facilitating physical activity and social cohesion. But also gives opportunities to strengthen green and blue infrastructures to meet ecology and sustainability goals. The new mobility network will be connected to a network of parking hubs were vehicles can be stalled when they are not driving.

This step will mainly contribute to the ambitions 1, 4 , and 5. Those are about 'slow traffic priority', 'healthy & clean environment' and 'accessibility'.

Due to the new mobility networks a lot of car free zones arise, on the district scale. The disentanglement of the networks resulted new areas which can be used for the community. These community areas are connected with each other by strong slow traffic routes. This together will form a network of community spaces in the neighbourhood. The routes and meeting places can give meaning to the neighbourhood in different ways.

This step contribute to the following ambitions: 1, 2, 3, and 5. Those reflect 'slow traffic priority', 'invites to move and meet', 'sport- and playground' and 'accessibility'.

The main focus in the design on the neighbourhood scale is creating areas and routes which are accessible for slow traffic and will stimulate and facilitate activity (physical and social). This is not done by only one step, but consists of a few different factors which can be drivers for stimulating activity. These drivers are safety, human scale, enclosure, complexity, transparency, and imageability. These drivers can all be used in different urban environment to trigger and invite people to move and meet. They are critical to a good walking and cycling environment, an environment which will activate people (NYC, 2010).

This step will mainly contribute to the ambitions 2, 3, and 5. Which reflects 'invites to move and meet', 'sport- and playground' and 'accessibility'.

Promoting physical activity through urban design at the micro scale (block scale) is one of the most effective measures to improve urban health. On top of this, strategies in reducing air pollution on the macro scale (city scale) will also be highly impactful in reducing diseases worsened by poor air quality. Besides, in the development of urban areas (on the neighbourhood scale) a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018).

In the other two scenarios not all design elements can be implemented yet. Mainly because the technology of automated vehicles is not fully developed yet. Cars cannot or are not allowed to drive fully autonomous or independent in these stages. But, there are a few design elements which can and should already start at an early stage. In terms of policies it is important to manage where automated vehicles are allowed to drive and where they should be parked. The other elements which can be implemented relate the more ‘analogue’ interventions which can be done in the built environment. There are for example ‘places to meet/sport/play', 'interconnected routes & roads', 'vehicle free zones', and 'public area accessibility'.

In designing for future neighbourhoods the design elements density and diversity become more important. Diversity reflects the variety of land use in an urban area, and the density reflects the concentration of services and houses in an area. In an area with a high diversity and density destinations are easier approachable by active transport. This is a good starting point in designing for new neighbourhoods. Afterwards, also the other design steps, as mentioned before, can be applied.

Answering research question

Returning to the research question:

‘‘How can the implementation of automated mobility contribute in improving urban health, in residential neighbourhoods in the city of Almere?’’

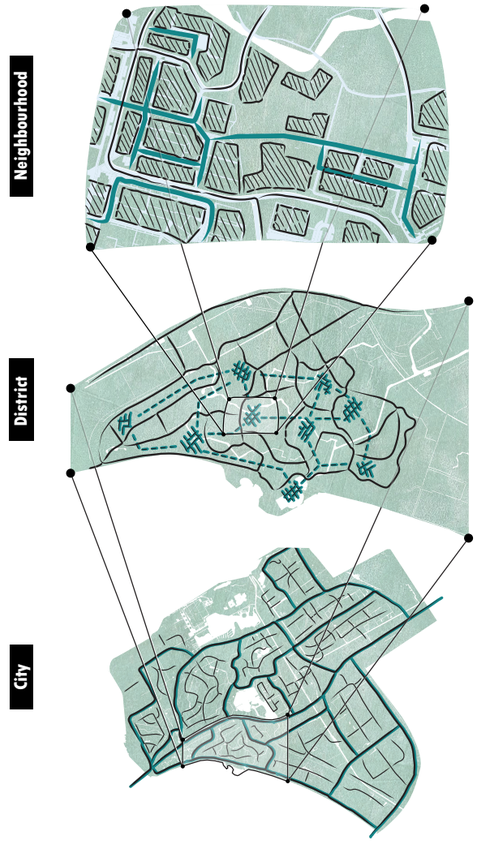


Image 142: 3 steps (own image)

Air and noise pollution are mainly caused by traffic in our cities. Whit the introduction of automated mobility alternative fuels will become the norm. This will decrease the air and noise pollution cause by mobility. Besides, traffic also causes a serious risk of accidents which can result in death or injury. On top of this, people's perception of danger from traffic also influences their travel behavior, especially among vulnerable groups (Pineo & Rydin, 2018). With the introduction of automated mobility, vehicles will be safer and cause less accidents. But besides these introduced advantages due to the technology of the automated vehicles, there arise also a few important opportunities.

The introduction of automated mobility offers the chance and opportunity to rethink the city and redesign mobility networks. A limited access of the autonomous vehicles is one of the main starting points for designing for a future with automated mobility.

The introduction of automated vehicles will give the opportunity to unravel the existing mobility networks. Some roads will be cut off, some will be diverted and some will be connected. By disentangling the networks new spaces will be created. Spaces which can form community spaces in the neighbourhood. A space where people can come together without being interfered by fast mobility. Slow traffic routes will be created towards the concentration spaces.

All the in between spaces can now be designed for stimulating and facilitating activity (physical and social). Also, the gained spaces can be used to strengthen green and blue infrastructures to improve the ecology of an area, which will support the urban health.

This all will only be possible when automated vehicles are allowed on a limited number of roads. Otherwise the vehicles will still dominate cities, and urban health interventions can not be carried out the way they should.

Besides, it is important that although autonomous vehicle networks are introduced, the rest of the city still has a permeable structure. This makes the city more accessible for slow traffic forms.

A remark here should be made. All of these recommendation are based on the developed progressive scenario. The scenario is based upon predictions and assumptions. However, it is uncertain what will happen on the long term. It is conceivable that the reality will differ from these predictions. Technology might not be as developed yet, or further developed than we can now think of. All depending on developments and trends. Another scenario will lead to another design and to other recommendations. However, scenario planning/designing is one of the only manners to deal with an unpredictable future.

When designing for the progressive scenario with the design elements for the healthy neighbourhood the following benefits and outcomes will arise. Concluding, on the macro scale the introduction of automated mobility is highly impactful in reducing air and noise pollution. Also, on this scale green and blue infrastructures can be enhanced to improve ecology. This will all reduce the chance of getting diseases which are related to the air quality and stress.

In the development of urban areas (on the district scale) a good accessibility to leisure facilities, healthy food, and public and green spaces can be integrated into the design to support health and well-being (Pineo & Rydin, 2018). A good accessibility, by active forms of traveling, to public spaces can contribute in stimulating physical activity. But it can also contribute in providing equal opportunities for people to make use of health stimulating or facilitating services.

Although, in developed countries health benefits tend to occur on the long term because of the healthier and extended lives, it is very important to design healthy environments now. The number of people with chronic diseases is continuously rising and this imposes heavy costs, mainly in the (social) health care. Promoting physical activity through urban design (on the micro scale) is one of the most effective measures to improve urban health and reduce chronic diseases and obesity (Pineo & Rydin, 2018). Besides, social cohesion can be undermined by barriers to pedestrian/cyclist connectivity. Creating safe and accessible environments where people can meet informally, can improve the social cohesion in neighbourhoods. This reduces chances in getting chronic diseases and depressions (Barton & Tsourou, 2000).

By creating healthy neighbourhoods with the guidelines provided in this project, both the mental and physical health of the society can be improved. Resulting in many different benefits, not only in health but also in many other sectors.

AMA and automated mobility

Bringing it to the bigger picture. Since the car was introduced the dominance of it started growing and growing. Now, the introduction of a new technology offers the opportunity to rethink the role of the car again. If we want to achieve healthy and sustainable environments, the dominance of the car should be reduced.

In addition, the AMA must be prevented from becoming a horizontal metropolis. Focus must be placed on making facilities accessible by active transport. Commuting and traffic flows should remain local where possible, so people do not have to transfer to the supra-local network every day. Local networks must be strengthened and the facilities structure must be well coordinated. Attractive and comprehensive living environments around existing cores should be created where people like to live, work and recreate. The AMA should use automated mobility as a supporting services to help move people and goods faster, cleaner and easier through an increasingly busier AMA. However automated mobility should be carefully managed to prevent that the vehicles will again dominate the metropolis, with as result a horizontal metropolis which cover the large part of the Netherlands. Automated mobility should be deployed in such a way that it will contribute to the urban health. This project gave suggestions in doing this.

Almere must stand out in the AMA by differentiation between living environments. In a time of the network society, where people start to live an increasingly individualistic life. The living environment can contribute to feeling connected to society. In addition, it is important that local infrastructures are properly connected, and sub-urbs are well connected to the core to which they belong. This again to prevent the city and the metropolitan region from fragmentation, and the automated vehicles taking over the space (again).



Image 143: City Thread / SPORTS (Archdaily, 2019)

REFLECTION

Reflection - project & process

Reflection project

Relevance

This project focusses of is on the impact of automated mobility on urban health in residential neighbourhoods. Two test locations in Almere were selected for this. The project responds to roughly 2 knowledge gaps. On the one hand, the gap in knowledge of the impact of the city and its elements on various aspects of health. Not enough research has been done to show how many and which elements support health. It is therefore important that a clear evidence-based framework is developed for different urban environments. This framework can provide insight into the impact of the various elements of the urban environment on different aspects of urban health, which can help urban planners to make decisions (Koohsari, Badland, & Giles-Corti, 2013).

This project seeks to respond to this knowledge gap by using case studies, existing literature and "research by design" to figure out which urban elements can contribute to improving urban health.

The second knowledge gap revolves around the impact of automated mobility on cities. The development and implementation of automated mobility is currently is still at an early stage. It is not possible to predict exactly what will happen on the long term and how automated mobility will influence our lives and our cities. This is partly determined by the speed in which the technology will develop and the response of the market.

This project attempted to use case studies to understand the impact of automated mobility on the city. However, because there are only very small scale examples it was not always easy to learn from them. Therefore, the scenario construction played a very important role in this project. They are partly based on case studies but mainly based on a range of predictions. Three scenarios have been developed based on a number of scenario factors. These formed the basis for designing with the uncertainty of the development of automated mobility. However, the scenarios themselves are an interpretation of the future, so it is very likely that the 'real' future will manifest differently. Strategies and design interventions will be based on scenario's which will be created. The design outcomes are therefore not applicable to all futures. Because, it is possible and highly probable that the automated mobility industry will develop in another way than predicted. This does not mean the research and design is completely useless. Depending on the evolution of the future some aspects of the design can be used in other scenarios. Also, this project provides guidelines in steering automated mobility and cities to later come to the favourable result.

Limitations

Public health researchers share the opinion that the built environment will probably have more effect on urban health than policies that influences health behaviour might have. With a redesign of residential areas and with the opportunities that arise through the introduction of automated mobility, the urban design is able to (partly) support and improve urban health. On a macro scale this is done by reduced air and noise pollution due to new introduced technologies in the automated vehicles. Also, due to the extra obtained space by disentangling the mobility networks, more space can be attributed to green and blue infrastructures, which can strengthen ecosystems. On a micro scale, urban design can support physical activity by designing inviting and safe public spaces. The accessibility of facilities by active modes of transport can also be improved in the redesign of the neighbourhood. However, despite the major role of urban design and planning in influencing urban health, there are several more factors that influence human health. This is mainly about providing care and teaching people. In this context, urban planning can provide the handles by facilitating facilities in the urban environment but cannot steer this. The scope of this project will therefore be limited to the urban design/planning discipline and the possibilities within it. This means that there are, in all likelihood, several more components that could improve urban health, to which this project cannot respond.

Reflection process

Start of the project – reflect critically

At the start of the studio and thus the project, the Amsterdam Metropolitan Region and the city of Amsterdam were appointed as main locations. For this reason, I started researching the city of Amsterdam. As the process progressed, and the main question of the process became clearer, the focus shifted more and more to residential areas. That is why I chose two residential areas within Amsterdam that could fit in well with the project for different reasons. However, after having worked with these locations for a few weeks, the city of Amsterdam turned out to be a too large city with too many facilities to use the two neighbourhoods as exemplary projects. The neighbourhoods were not comparable with other neighbourhoods in the Netherlands. The story about the suburbs (isolated neighbourhoods with a limited number of facilities) would not be supported by these two neighbourhoods. On the advice of my first mentor, I started looking further than only Amsterdam, and then came to Almere.

This situation illustrates that reflecting critically on your own decisions is of great importance. The project changes day by day and so does the focus and scope of the project. You must review decisions that you have made earlier. In addition, sometimes decisions are based on assumptions or because you are dragged into a certain direction (studio location). It is important to reflect critically on what you have put down and how this may have changed through new decisions that you have made gradually. An important learning moment in the process. At that moment in the process, this may have been missing. I focused too much on the decisions I had already made, until I was told. A point of attention that I continued to work with during the rest of the project.

Be precise - what do I want to know

During the process you gain a lot of knowledge and information. All equally interesting, but what exactly do you want to know. It is therefore also important to be sharp and precise. At the start of the process this sharpness is still lacking (logically because this is part of the initial phase), you investigate broadly and step by step it becomes clearer what you want to know and want to research (and design). This, making your mindset clear was not always easy in the process. For example, in defining the questions about the health aspect in the project. Many different

approaches preceded the final definition of the research question and the project. Matrices and diagrams helped me to make my own thinking clear for myself and for others. I have noticed that it is easier to discuss it with others in this way. A method that I started using more and more throughout the project. I did not only create this sharpness in theories. Applying sharpness and precision to your design allows you to think about how systems work. When you have given this sharpness to a situation, you can again look critically and test whether this has been the right solution/ direction/step. If this is not the case, you can revise it.

However, sticking too strongly to the created matrices does not always lead to a desired result. I noticed this when I started designing more. For example, I made a scheme with a number of possible interventions for improving health in residential areas. I firmly adhered to this at the beginning of the design. However, this often did not lead me further into the design steps. Waiving the created toolboxes again gave me the freedom to continue in the design process.

In conclusion, there is nothing wrong in sharpening your project. In fact, it helps you further. Matrices and schemes can be very useful for this and work in an accompanying manner. However, fully adhering to created toolboxes deprives the freedom in the design process. Once the design phase has been completed, it is possible to refine the matrices again.

Dream
The third learning moment builds on the above. Dare to dream. Sometimes it is necessary in a (creative) process to let go of everything that you have researched. At times in the process, I did not do this enough. I often try to base decisions on earlier research, which is also valuable. However, taking a step back and thinking what I want with, for example, a design is just as important. By daring to dream big, the best ideas can arise. A step that I sometimes have to commit myself to but is very valuable for the process.

Turning point
The final learning moment was one of the last weeks of the project. At the fourth presentation I got some feedback and advise from my mentors. One of these advises was to start focussing on the recommendations as 'end' product in stead of focussing too much on the design. A hard step to make, but these turning points in processes can be very valuable. At first it seems maybe as going into the wrong direction, but it can also bring the project a step further. Turning points in a process gives the opportunity to reflect critically on what you did before and what is needed for the 'new' 'end' product. The turning point in the last weeks of the project helped me finalise and conclude all the structures I put together in the whole project. And it led to a stronger message and image in the end.



Image 144: Superkilen / Topotek 1 + BIG Architects + Superflex (Archdaily, 2012)

Literature **266**
Images **272**

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Image 113. *own image*
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Image 139. *own image*
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Image 145: Ribeiro do Matadouro Park / Oh!Land studio (Archdaily, 2015)

APPENDIX

Theories of urban planning and design

Reconnecting Urban Health and Urban Planning
A review paper on the challenges and actions needed to reconnect the disconnected fields of urban health and urban planning

Abstract
The idea that human health is inevitably linked with environmental conditions is becoming more and more common (Jackson, 2003). Although, in the last couple of years, there is expanding number of studies produced, the relationship between health and planning still remains a relatively under-explored topic. Yet, urban planning research has a strong potential to link with studies of urban health (Boarnet & Takahashi, 2005). Combined research is needed to identify when the built environment has negative or positive impacts on health. Therefore, suitable design interventions have to be developed to reduce adverse health effects (Srinivasan, O'Fallon, & Dearry, 2003). Nevertheless, these fields share similar objectives, their methodological approaches differ.
Although these fields are primarily focused on different strategies, there is a growing recognition that both approaches are essential for achieving significant changes. It is therefore important that researchers within the two fields cooperate (Hoehner, Brennan, Brownson, Handy, & Killingsworth, 2003). In this paper the following question is leading: ''How can the fields of urban planning and urban health be reconnected to plan for healthy cities/neighbourhoods?". This question will be tackled by means of a literature review.

Key words: Urban design, urban health, difference in strategies, reconnecting, multidisciplinary approach

1. Introduction
Although public health's and urban planning's combined efforts in preventing urban outbreaks of in infectious diseases in the 19th century, the disciplines separated (Corburn, 2004; Hoehner et al., 2003). This has led to uncoordinated attempts to address the health of urban populations (Corburn, 2004). The influences on urban health created by environmental factors, are still not fully understood by many planners (Srinivasan et al., 2003). Determinants like density rates, the quality of public spaces, and accessibility of public transport can be linked to several risks in urban health like physical inactivity, obesity and chronic diseases (Hoehner et al., 2003; Koohsari, Badland, & Giles-Corti, 2013). Although urban planning only is not able to improve the public health, it has a big influence. Changes in the built environment have potentially more influence on the physical activity than policies, which aim for influencing individual behaviour, will have (Frank & Engelke, 2001). Therefore, it is needed to reconnect the fields again, so planners understand which health benefits are produced by design interventions (Boarnet, Greenwald, & McMillan, 2008). However, there are a few significant challenges which prevent the fields from reconnecting. For example, the methodological approaches between the fields differ. It is necessary to bring the both fields together again, because both approaches are necessary in achieving changes in health behaviour (Hoehner et al., 2003).

Therefore the following research question is leading: ''How can the fields of urban planning and urban health be reconnected to plan for healthy cities/neighbourhoods?". This will be done by means of a literature review. First, urban health will be addressed, its urgency and conditions. The following chapter will focus on urban planning and how it can be used to plan/design healthier cities. Then, the disconnection and the urgency to reconnect will be addressed in chapter 4. The reconnection of the fields urban planning and urban health will be tackled in the next chapter. The paper will be concluded with the conclusion and recommendations for further studies.

2. Urban health
Over half of the world's population lives in urban areas. And, it is projected that 66% of the world's population lives in cities, by 2050. Good planning and governance will allow economic and social development in these urban settlements. However, sustainable development is threatened when this growth advances rapidly and unplanned (United Nations, 2015). The trends in urbanization have significant effects on living conditions and the environment (United Nations, n.d.). Although living in cities brings individuals and families great opportunities, also some health risks emerge due to urbanisation. These risks vary per city and local context. Common urban health risks and social challenges contain:

•''Infectious diseases exacerbated by poor living conditions.
• Non-communicable diseases like heart disease, cancers, obesity and diabetes. This can be caused by unhealthy diets and physical inactivity.
• Accidents, injuries, violence and crime."
(World Health Organisation, 2010, p. 9)

To ensure healthy lives and promoting well-being for the whole population, improving health will remain a global priority. It contributes in realizing human potential and helps to create equitable, inclusive and economically vibrant cities (World Health Organisation, 2016).

There are, according to the World Health Organisation (2010), five actions needed to build a healthy and safe urban environment:

• ''Promote urban planning for healthy behaviours and safety.
• Improve urban living conditions.
• Ensure participatory urban governance.
• Build inclusive cities that are accessible and age-friendly.
• Make urban areas resilient to emergencies and disasters."
(World Health Organisation, 2010, p. 15)

The healthy neighbourhood constitutes, according to Micintyre, Ellaway & Cummins (2002), of the five following types of features:
• "Physical features of the environment shared by all residents in a locality.
• Availability of healthy environments at home, work and play.
• Services provided, publicly or privately to support people in their daily lives.
• Socio-cultural features of a neighbourhood.
• The reputation of an area."
(Macintyre, Ellaway, & Cummins, 2002)

Although, many times is listed what a healthy city or neighbourhood should constitute. There is still a need for study on the features/elements needed in social and physical environments which promote urban health, and there should be an increased focus on the effect of the place on urban health (Macintyre et al., 2002).

3. Planning urban health
Within a multi- and interdisciplinary field, urban planning is a profession in which plan-

ners strive to improve the welfare of individuals and communities guiding development of the built environment (Kochtitzky et al., 2006). Concerning the interaction between communities and environments (Boarnet & Takahashi, 2005), urban planners contribute to creating ''more convenient, equitable, healthful, efficient, and attractive places now and for the future" (Kochtitzky et al., 2006, p. 34). There is a wide range of different sectors, tasks and objections in urban planning. What they have in common is the mission to find solutions to community problems (Boarnet & Takahashi, 2005). Knowledge of social sciences and urban design are combined in the field of urban planning, where the physical environment meets the social environment. All processes, like social, political, economic and historical processes, have to be taken into account to create convenient physical compositions of systems in transportation, land use, housing, public open spaces, and so on. These are important factors of planning for public health (Northridge & Sclar, 2003). In fact, the fields of urban planning and public health have common perspectives and aims. Improving human well-being, emphasizing needs and managing social systems, focusing on the needs of vulnerable populations are all shared missions of the both fields. However, both the urban planning as the public health fields have expanded their approaches, tools and perspectives. Where the public health field is more focused on biomedical models, the field of urban planning relies more on geographical models (Kochtitzky et al., 2006). Although the fields broadened their perspectives, "urban planning and public health have been intertwined for most of their histories" (Kochtitzky et al., 2006, p. 34).

To understand urban planning from an urban health perspective in-depth, urban health can be redefined using planning terminology. There are about five themes that guide urban planners in dealing with urban health. First, economic development is one of the main drivers of urban planning. Including themes as transportation, housing, and community development it is concerned with economic vitality of communities and cities. Considering the urban health perspective, economic development investigates uneven wealth distributions and poverty (Boarnet & Takahashi, 2005).

Secondly, urban design plays an important role in guiding urban planning. Urban design combines physical structures whit social environments. In public health researches, urban design has become one of main focuses. For example, researching the role of land use development patterns in the levels of physical activity and health behaviour (Boarnet & Takahashi, 2005).

Thirdly, another theme that guides urban planning and urban health is equity and social justice. This theme concentrates on strengthening socially, politically and economically disadvantaged communities, by providing expanded health care services (Boarnet & Takahashi, 2005).

Fourthly, governance and institutional management guide urban planning practices and urban health by governing in many places and at many scales mechanisms that provide sustainable, social and community programs. Besides it refers to urban health care delivery (Boarnet & Takahashi, 2005).

And finally, sustainability focuses on the whole of an urban environment. Focusing on human capital, social capital, resources usage, it also includes physical and mental health of communities (Boarnet & Takahashi, 2005).

However, all these guidelines many planners still do not fully understand the impact of built environment factors on urban health (Srinivasan et al., 2003). To select useful indicators for the built environment, to monitor progress and effectiveness of proposed urban health promoting programs and policies, a joint urban planning and urban health framework can help (Northridge & Sclar, 2003).

4. Disconnection urban design and urban health

The fields of urban planning and public health share common roots (Frank & Engelke, 2001). In the late 19th century both fields had the same aim in preventing urban outbreaks of infectious diseases in overcrowded cities. During this era, planning and public health were regularly linked with contagion and miasma. However, some symptoms in the health of the populations back then, like why epidemics took place sporadically and how the diseases travelled, could not be explained by miasma and contagion (Corburn, 2004). The disciplines of public health and urban planning went their separate ways (Corburn, 2004; Hoehner et al., 2003).

Within the public health field, the main ideologies had shifted from planning to germ theories. These ideas occurred by the end of the 19th century and continued until the first half of the 20th century. Instead of researching ways to improve urban infrastructure, the discipline of public health focused more on laboratory investigations on microbes. Microbes were labelled as one-to-one cause of specific diseases. Physicians became the new professionals of this field (Corburn, 2004).

In urban planning the Haussmann model became leading. This model was based on ordering functionalities. Residential areas were separated from industrial areas. By means of this zoning theory populations were immunized from undesirable externalities (Corburn, 2004).

By the second half of the 20th century the field of public health shifted towards focusing on the host of the disease, rather than the environment. Namely, the environment was harder to control and influence for the public health professionals, the physicians (Corburn, 2004). This individualism emphasised the role of individual lifestyles in chronic diseases. Social dimensions of disease were ignored and risk factors in health were based on individual choices, like drinking, smoking, diet and exercise (Corburn, 2004; Macintyre et al., 2002).

The planning industry started to focus on economic development. Promoting suburban economic development was one of the key ideologies in that time. Economic efficiency was leading, and residential segregation took place (Corburn, 2004). This post-war economics caused a population-level reliance on cars for daily use. Due to urban sprawl, people need to travel longer, which is linked with traffic congestions and increased pollutions. This reliance causes low physical activity levels in a lot of suburban areas among many industrialized countries (Badland & Schofield, 2005). All factors which have an influence on the public health.

The health industry was by the second half of the 20th century mainly focused on the biomedical models explaining diseases. Individual lifestyles, behaviours, and genetics were rigidly entrenched in epidemiology theories. However, how the diseases were distributed among populations was not explained (Corburn, 2004).

Urban planning adopted by that time

the environmental impact assessment (EIA). The EIA process, however, have been widely criticised as method for assessing population health. Yet, the extensive adoption of EIA leads to a disconnection between planning and environmental health (Corburn, 2004).

It is necessary to bring the both fields together again, because both approaches are essential for achieving significant changes in health behaviour (Hoehner et al., 2003). By reconnection of the fields of urban planning and public health the shared aims and objectives can be restored (Northridge & Sclar, 2003).

5. Reconnection urban planning and urban health

After years of disconnection the two fields, urban planning and urban health, have begun to reintegrate the since last two decades (Hoehner et al., 2003; Kochtitzky et al., 2006). Within the field of urban health subjects like physical inactivity, obesity, and other lifestyle related chronic diseases became more pressing. Within the field of urban planning there were growing concerns about environmental impacts of the use of the car. This developed into shared concerns -among other things- regarding air quality, physical inactivity, parks and green in the cities and injuries in traffic (Kochtitzky et al., 2006).
However, since the fields have been disconnected for a while, they developed different strategies for addressing similar problems. While the urban planning field focuses on measures shaping the built environment, the field of urban health emphasises more on individual interventions (Hoehner et al., 2003). Although the growing recognition for collaboration between the fields, the fields face also new challenges in reconnecting again (Corburn, 2004).

Corburn (2004) describes four challenges. First, he expresses that an increased attention to public health effects of the built environment are needed. Also, it must be recognised that the field plays an increased role in political processes of place-making. In order to reconnect the fields urban planning has to form a set of outcomes and processes that:

- ''Involve the use or abuse of power
- Respond to or resist market forces
- Work to empower certain groups and disempower others
- Promote multiparty consensual decision-making discourses or simply rationalize decisions already made"

(Corburn, 2004, p. 543)

In conclusion, it is needed that the role of politics is acknowledged in planning practice (Corburn, 2004).

Secondly, it is needed to eliminate health disparities by developing a multidisciplinary approach. Increased evidence is emerging that disparities in health between people of different colour is linked to physical and social environments (Corburn, 2004).

Thirdly, he describes that the two fields have to develop an urban health agenda together. This is urgent for emphasizing the significance of urban health disparities. The lack of a shared agenda leads to a minimalization in research about urban issues (Corburn, 2004).

Fourthly, it is criticised that decision-making in both fields of urban planning and public health are not democratically shaped. Often there is a lack of contextual knowledge and experiences. Therefore, to ensure that communities, which have been excluded from decision-making, can also have their voice in planning practices, a new participatory democracy have to developed (Corburn, 2004).

Hoehner et al. (2003) discuss in their paper the difference in strategies for addressing urban health related problems. Public health researchers focus more on individual interventions, where the urban planning practitioners focus on measures that shape the built environment. To develop cross-cutting frameworks participation and collaboration of the both fields will be necessary. Theories within the field of public health are related to identifying factors that influence health and behaviour and the determination and implementation of program and policies. Within the field of urban planning, theories are less pronounced. It limits itself to identifying factors to explain an predict travel behaviour. A multidisciplinary collaboration is needed to develop design models which can guide urban planners in developing cities which can improve urban health (Hoehner et al., 2003).

Shrinivasan et al. (2003) stresses as well that it is needed, besides collaborative partnership, to adopt multidisciplinary research approaches to create awareness of urban health. Indicators and measures can be defined and developed better within a multidisciplinary collaboration to understand associations and links within the both fields (Srinivasan et al., 2003).

Koohsari et al. (2013) describes that there is a lack of knowledge and evidence for urban planners and policy-makers about 'what types' and 'how much' elements in the built environments are needed to support urban health. Creating a clear guidance for a range of built environments, including thresholds and geographical scales provides urban planners with knowledge on how to plan for a healthier city. Koohsari et al. (2013) argues that providing the thresholds and geographical scales will help progressing the research translation from public health through urban planning (Koohsari et al., 2013).

Besides, Macintyre et al. (2002) argues the lack of scales as well. Spatial scales which are appropriate for meeting different needs, and at what scales information is available, have to be determined (Macintyre et al., 2002).

6. Conclusion

In this paper the following question was leading: "How can the fields of urban planning and urban health be reconnected to plan for healthy cities/neighbourhoods?". This has been investigated by reviewing a couple of papers to understand what the reasons where for the disconnect and what the challenges and steps are for a reconnection.

Despite the fields of urban planning and urban design share common roots, the fields were largely disconnected (Corburn, 2004; Frank & Engelke, 2001). The disciplines of public health and urban planning went their separate ways (Corburn, 2004; Hoehner et al., 2003). The field of public health focused primarily on the laboratory investigations on microbes and the health risk factors caused by individual choices (Corburn, 2004; Macintyre et al., 2002). The host of the disease was investigated, rather than the environment because this was harder to control for health professionals (Corburn, 2004). The urban planning field at the same time started to emphasise on economic development, residential segregation due to suburban development took place (Corburn, 2004). This has

led to a bigger reliance on the car for daily use. This in turn resulted in lower physical activity levels, leading to a number of health issues (Badland & Schofield, 2005).

It is necessary to bring the both fields together again, because both approaches are essential for achieving significant changes in health behaviour (Hoehner et al., 2003). However, although the growing recognition for collaboration between the fields, the fields face also new challenges in reconnecting again (Corburn, 2004).

Corburn (2004) describes the importance of acknowledgement of politics in planning practice and place-making, also he emphasizes the importance of a multidisciplinary approach, besides he elaborates on the urgency of the development of a shared urban health agenda, finally he puts forward the significance of a new participatory democracy within the both fields.

But besides Corburn (2004), also Hoehner et al. (2003) and Shrinivasan et al. (2003) describe the importance of a multidisciplinary collaboration and approach. This shared approach is needed to develop design models which can guide urban planners in developing cities which improve urban health. Indicators and measures should be determined and developed better, within a multidisciplinary collaboration, to understand associations and links within the both fields (Srinivasan et al., 2003). A joint urban planning and urban health framework can help with this (Northridge & Sclar, 2003).

Along with the development of a shared approach and framework, Koohsari et al. (2013) and Macintyre et al. (2002), emphasise on the importance of determining geographical scales. Geographical scales which are appropriate for meeting different needs, and at what scales information is available, have to be determined (Macintyre et al., 2002). This can help urban planners and policy-makers to determine 'what types' and 'how much' elements in the built environments are needed to support urban health (Koohsari et al., 2013).

Concluding, for reconnecting the fields it is important that there is a multidisciplinary collaboration and that a multidisciplinary approach, with a guiding framework, will be created. This approach can help select useful indicators for the built environment to monitor progress and effectiveness of proposed urban health promoting programs and policies (Northridge & Sclar, 2003). Geographical scales need to be determined which can be suitable for different needs and which can provide suitable information (Koohsari et al., 2013). Besides, it is useful to create a shared urban health agenda. A shared agenda will lead to more focused research about urban health issues (Corburn, 2004).

7. Recommendations

Now the fields of urban planning and urban health are slowly making attempts to reunite again, concerning the levels of physical activity and the impact of cars, it is important that there is a multidisciplinary collaboration. A multidisciplinary approach and framework should be developed to help guiding urban planners to design for improving urban health in cities and in neighbourhoods. Therefore, it is recommended to do more research on forming a shared conceptual framework and methods which can be used for shared goals in planning strategies for healthier cities.

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Healthy Neighbourhoods
A research and design project investigating the impact of automated mobility on urban health in residential neighbourhoods in Almere

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