RECYCLE CITY
STRENGTHENING THE BIKEABILITY FROM HOME TO THE DUTCH RAILWAY STATION.
NOOR SCHELTEMA
“I want to ride my bicycle, 
I want to ride my bike, 
I want to ride my bicycle, 
I want to ride it where I like! ”
(Queen, 1978)
RECYCLE CITY
STRENGTHENING THE BIKEABILITY FROM HOME TO THE DUTCH RAILWAY STATION.

NOOR SCHELTEMA
Almost a year flew by since I started with my graduation project. Before the graduation year began I was already orienting on the subject of my thesis. In spring of 2011 I had just made the decision to study the bicycle network between home and the Dutch railway station. Both, the railway station environment and cycling, had caught my interest. Station areas always had my fascination. They are the bustling nodes where the society comes together. And cycling is not only the most effective form of transportation within the city, but also forms the perfect combination with the train. From the beginning on I wanted to do my graduation project at a company. Therefore, I could not imagine a better place to do my graduation project than NS Stations, the real estate division of the Dutch Railways (NS) and the biggest actor in the field. When they offered me the opportunity to graduate at NS Stations I was very pleased and eager to start.

Until now, I could hardly imagine to work with enthusiasm on one subject for a whole year. But all inspiring, ambitious and skilled people surrounding me, encouraged me through the whole year and always motivated me to continually improve my thesis.

First, I would like to thank my mentors Sebastiaan de Wilde and Inoek Brouwer for giving me the opportunity to graduate at NS Stations. And for their inexhaustible enthusiasm and dedication to the project.

Furthermore, I would like to thank my mentors at Delft University of Technology, Remon Rooij and Stefan van der Spek, for their support and drive to get the best out of me. And for their tremendous amount of knowledge on the subject and the ability to look at all aspects of the problem.

The past year I have had some very inspiring conversations with experts from, among others, municipalities, ministries, institutes, design offices and other related companies. They allowed me to put my graduation research into a broader perspective and link it to practice. And of course I would like to thank my colleagues at NS Stations for the inspiring conversations we had on the subject of the thesis.

Last but not least I want to thank Michiel for always being there for me and my parents who have always supported me.

Noor Scheltema
Delft/Utrecht, June 2012
In Dutch culture, cycling and walking are the most common ways of active transportation within the city (Heinen, 2011). Nowadays, more than forty percent of all train passengers arrive at the railway station by bicycle. And it is estimated that the combination of bicycle and train will become even more important in the future (Venhoeven, 2010). But the spatial quality of the bicycle network from the Dutch residential neighbourhoods to the railway station is often poor: uncomfortable and incoherent. Urban design might and should bring solutions. Unfortunately, the cyclist’s perspective is worldwide under-represented in even the most comprehensive work of urban design (Forsyth & Kryzek, 2011).

This thesis aims to develop spatial design interventions to improve the bikeability from home to the Dutch railway station. The target group exists of bicycle commuters, cycling from home to the railway station to take their train to the city they work in. The main research question of the thesis is:

**What spatial design interventions can create a strong, consistent and attractive bicycle network to strengthen the bikeability from home to the Dutch railway station?**

The spatial design interventions to improve the bikeability to the railway station can be found by:

1. A literature study that critically assesses a number of leading authors in the field of the design and planning of public space. The study results in a list of conditions for successful public space for cyclists.
2. A case study research on eleven comparable Dutch bicycle routes. For this research a validation tool is developed to test the quality of each bicycle route. This tool is based on literature study and feedback from the case study research.
3. A design to improve the bikeability for the bicycle routes and the station area in Amsterdam Amstel.

1. **Literature study: Part B**
The objective of the literature study was to develop a list of conditions for successful public space for cyclists. This list is based on literature review of leading authors in the field of urban design and planning. The study resulted in a pyramid of four hierarchic divided conditions, sub divided in twenty measurable conditions (see pyramid and list on the right).

2. **Case study research: Part C**
For the case study research the list of conditions was developed into a validation tool and worked out in a manual (part D) to measure the quality of eleven comparable bicycle routes. The end result of this research gave a first understanding in the current quality of the bicycle routes in the Netherlands.

3. **Design: Part E**
From the eleven bicycle route, Amsterdam Amstel as chosen as test case to make a design for since its low score and high potential. The validation tool was very useful in the design process, but it became clear that the position of the project area should be reconsidered on the level of the city to fit the activity network of the city.

**Improving the bikeability: Part F**
The main research question of the graduation project can now be answered in three steps:
1. First, the bicycle route from home to the railway station should be validated with the ReCYCLE City tool. The outcome pinpoints the strong points and opportunities of the bicycle route and recommendations to improve the bicycle route from home to the railway station.

2. The second step is to analyse the city in a larger perspective. This can give insight in creating shortcuts that work even better. Putting the bicycle route in large perspective also helps to get an overview of the activity network in the city in order to integrate the functions as part of the city.

3. Finally, use the conditions for successful public space for cyclists to make spatial design proposals, namely: safety, directness, comfort and attractiveness.

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1. Safety
   a. Road division
   b. Visibility & lighting
   c. Pavement

2. Directness
   a. Linearity
   b. Continuity
   c. Right of way to bicyclists
   d. Orientation
   e. Fluency
   f. Flatness
   g. Legibility
   h. Transfer distance
   i. Bicycle parking capacity

3. Comfort
   a. Human scale
   b. Special bicycle amenities
   c. Bicycle parking types
   d. Bicycle racks
   e. Bicycle parking levels

4. Attractiveness
   a. Maintenance
   b. Liveliness
   c. Experience

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- condition can only be met if ones below are fulfilled.
- pre-conditions for the one(s) above
- fundamental pre-condition for all others.
Reading Guide

In front of you lies the first booklet that contains part A, B and F of the ReCYCLE City Master’s thesis. This booklet is part of graduation project ‘ReCYCLE City’ of the masters of Urbanism at the faculty of Architecture of Delft University of Technology.

This Master’s Thesis consists of six parts.

Part A contains the introduction of the thesis. The problem field, the objective, research questions and methodology are discussed.

Part B forms the theoretical background of the thesis based on a literature study.

Part C discussed a case study research of 11 bicycle routes. Every case is analysed and compared by the developed validation tool. Literature study forms the basis of this case study research.

Part D contains the guide for the validation tool that is developed as a result of the literature study and the case study research.

Part E shows the design made for the bicycle routes and the station area in Amsterdam Amstel. This part shows how the results of the theoretical framework and the case study research can be used to develop a strategic design for the project area.

Part F draws the conclusions of the work and presents the recommendations for further research.
# PART A – THESIS PLAN

## THE LOST CYCLIST

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This introduction of the thesis plan first sketches an impression of the problem that triggers this thesis. Then it describes the context of the railway stations and the bicycle networks in the Netherlands. After the context is defined the problem statement follows that sets the base for this graduation project.
1. PROBLEM FIELD

1.1 Back to Work

The alarm clock goes. It is Monday again: back to work! Like most of your friends you have this typical ‘metropolitan’ lifestyle. While you live in your old student city Delft you have found a nice job in Amsterdam. The distance is no problem as both cities in the Dutch metropolitan region have a very good train connection and your work in Amsterdam is just next to the station. You only have to cycle from home to the railway station to take the train...

After a shower and some breakfast you hurry outside to your bicycle. You unlock your ‘station’ bicycle and, still walking next to your bicycle, manage yourself through a narrow alley. Then you start cycling. First you manoeuvre your bicycle through a car parking area in front of your house. When you finally reach the street you sway around some parked cars. At the end of the street you can just stop in time when a car that did not notice you leaves his parking spot.

Recovered from the shock you cycle further out of your neighbourhood until you reach the traffic lights where you have to wait a few minutes. You look at your watch and see that your train will depart in eight minutes. After the light turns green you cycle a little bit faster until you reach the next traffic light. When these light turns green you want to cycle straight ahead but the cars that turn right block your way. Seconds tick away. You put up the tempo and cycle next to the busy regional road in the direction of the train station.

When you reach the train station area some unloading trucks in front of the supermarket at the access street force you to step off your bicycle and take a diversion by the pedestrian path. Back at the street again you take a sprint with the railway station still out of your sight. When you pass the corner you suddenly have to stop. Some stinking buses pass. You can already see the bicycle station parking behind the busy road and a dizzying station square where buses, trams and cars are all over the place. When you see no other way to go there you decide to brave the danger and you throw yourself in the traffic bubble in front of the railway station. Looking back you cannot imagine how you have managed this but that does not matter right now as you are glad to reach the bicycle parking. You cannot find any free parking spot so you put your ‘station bicycle’ with some force in between them and lock it to a fence. You look at your watch. The train departs in one minute. Now you have to run to catch your train; over the bus platform, along the cycling path, though the slow crowd, to the station hall, through the tunnel, up to the platform. The conductor whistles. Just before the doors close you manage to get in the train. You sit down, regain your breath and relax. A regular day has started...

The situation that is sketched above seems exaggerated but unfortunately this is part of everyday life for 1.2 million cyclists every weekday in the Netherlands (Fiets Filevrij, 2011). In many Dutch cities a comfortable and coherent bicycle route from home to the railway station is missing. Dutch neighbourhoods and railway stations are often not well integrated with the urban structure of the city. Neighbourhoods and the routes to the station are often too much car oriented which does not stimulate active transportation in the city.
Figure 1.1 Movie strip sketching the issues of cycling from home to the railway station
This makes people rather take the car instead of other transportation modes, also on local base. The multi-modality of the railway station is often visible as chaos in front of the station whilst it could so much be used as an opportunity. The acknowledgement of solving these issues in an integrated way as part of the urban fabric is widely known (Venhoeven, 2011; Rooij & Read, 2008).

This thesis discusses the inappropriate bicycle routes towards the railway station. Furthermore it explores spatial design interventions in order to improve the bikeability from home to the railway station. The following sections go further into the problem statement of the railway station and the bicycle networks. There the objectives, research questions, methodology and the relevance are set out.

1.2 Commuting as major travelling purpose

Every day more than twenty percent of all trips are commuter trips in the Netherlands (figure 1.2). Commuting is one of the main purposes of travelling (CBS Statistics, 2010). The Dutch spend the most time on commuting and cover the largest commuting distance compared to other countries in Europe.

The benefits of commuting have an individual and a national touch. Commuting offers a form of individual freedom since living preferences are not restricted by distance to the work location. This makes it easy to change jobs whilst keeping the same residence and the other way around.

Commuting is characteristic by its time and space concentration. Early in the morning workers leave home and return at the end of the afternoon or evening. This predictable rhythm repeats itself every working day. The country also benefits from commuters while commuting enlarges the economic activity of the urban areas (Heinen, 2011).

This thesis addresses commuters as the main target group for research. The reason of this focus is that commuting covers the largest amount of trips that are daily made in the Netherlands. In the second place, commuting is characteristic through its interdependency on various transport modes. And the time and space concentration of the event taking place. The trip from home to work can only be made by using a combination of at least two active and/or passive transportation modes. And whatever transportation mode you choose, as commuter you always begin and end as pedestrian. Therefore it is important to optimise the strength of the different transportation modes in the limited span of time and space.

Finally, some of the most common transportation modes have a negative impact on the environment. For example, car commuting causes air and noise pollution and requires expensive infrastructure in areas where space is scarce and expensive.

The following chapter goes further into bicycle and train commuting as they are being seen as the promising combination of transportation mode.
Figure 1.3 Faster railway networks brings regions closer together and makes travel distances shorter (Trip, 2007).

Fig. 1.2 Commuters travelling every weekday from home to work

> 20% of all journeys

Fig. 1.4 Commuters travelling every weekday from home to work
1.3 The expanded spatial reach of train commuting

Every day the railway station serves as a gateway for more than 1.2 million people (NS, 2010). The railway station has developed itself through the last decades as a major hub between the cities in the Netherlands. In the future the railway station node becomes even more important. The mobility of people has increased largely due to modern transport and telecommunication technologies and the economic developments in Western Europe the last century. The technological innovations has led to a new sort of approach where the distance constrains are now minimised by time constrains. (Rooij & Read, 2008; Trip, 2007).

As a result, the catchment area of the urban inhabitant has expanded enormous while at the same time the action radius has grown largely the past decades (figure 1.3). In the 17th century for example the Dutch travelled 40 kilometres on average per year. This distance is now travelled every single day (CBS Statistics, 2010).

Today, the train is the fastest, most comfortable and cheapest mode of transport on regional and national scale compared to the private car (see figure 1.4). The weak link of train transportation is the poor door-to-door connection. Other motorised traffic, like the motorbike and the taxi, lack in terms of comfort and costs. The public transport modes as bus, tram and metro, reach up to the regional level but these are not cost-effective.

The extended growth of mobility has increased the pressure on the infrastructure and its environment. The upcoming climate issues increase the importance of the debate on sustainability and the right choice of transportation. In today’s politics this seems to be a touchy subject. When considering the side effects on the environment, public transport still comes out as the most sustainable investment in mobility (figure 1.5).

The railway station evolved itself as a multi-modality node where all flows of the buses, trams, cars, cyclists and pedestrians pass each other. This often results in a very complex situation at the railway station square which looks like a chaos of traffic modes. The station square mainly serves the traffic flow instead of the people. The quality of public space leaves much to be desired. People on foot or bicycle are forced to step aside.

The entrance of the railway station has become of huge importance for the city since more and more people are travelling by train. More importantly the railway station forms the major port to other cities connected to the railway network (Venhoeven & Van Velzen, 2010). The Dutch Railways (NS) have come to understand their important of their place in the network. They realise that the experience of the journey through the customers eyes plays a main role in the overall impression and functioning of the station. The railway station is a multi-functional node which should continue outside the station building. Advanced studies among the customers show the different types of users of the station. This is helpful in meeting the needs of the customers to offer them a pleasant transport as well as a pleasant transfer journey. The railway station is developed as multifunctional node from which transportation is only a part. Next to the travelling purpose the railway station is now a place for shopping, having a business meeting, doing
Figure 1.5 Conceptual comparison between the transport modes of car, BTM (bus, tram, metro) and train (Interpretation from Bertolini et al., 2003)

Fig. 1.6 Rotterdam Central Station as multifunctional node in the urban web (NS, 2011)
a work-out, meeting friends, having lunch or dinner, or just to start the morning with a newspaper and a cup of coffee.

The extended development inside the station building has excessive impact on the city’s life, as public space inside the railway station is not restricted to the entrance of the station. The multifunctional node of the railway station is not only part of the railway network (see figure 1.6). It serves a larger public outside the railway station in which many actors are involved. The municipality comes into the picture first since the station square is part of the city’s public space. Other actors involved at the station square are for example the participating transportation companies of the bus, tram, metro and taxi, and of course the real estate owners. The Dutch Railways realise they should take part in this integral planning process to improve the interaction of public space between the city and public domain of the railway station.

1.4 Bicycle commuting as key access mode

In the Netherlands, cycling is beside walking the most important way of active transportation within the cities. Cycling is deeply integrated in Dutch culture as more than ninety per cent of the Dutch has a bicycle. At least a quarter of all trips are made by cycling, especially on local and small regional scale (see figure 1.7). Well over five million people use the bicycle every weekday for one or more trips in the Netherlands (Fiets Filevrij, 2011).

Cycling also has a lot of societal and individual advantages (see figure 1.8 below). First of all, cycling is a cheap form of transportation and is healthy while it prevents you from all kinds of diseases. Cycling offers you above all flexibility to move whenever and wherever you want to go and often has a high recreational value. And sometimes even faster than other transportation modes. The last point proves to be one of the main reasons for people to take the bicycle.

Next to these individual advantages there are also several advantages of which the society benefits; cycling does not take up much space. Besides walking, cycling is the most sustainable way of active transportation as it has no direct emissions. Another advantage is that cycling is part of a common Dutch habit. Almost everyone has a bicycle and cycling improves the public health. More importantly, a relative small investment is needed to facilitate bicycle use compared to other transportation modes (Heinen, 2011).

Last but not least, cycling even generates profit. Research by the Danish government pointed out that a cyclist makes a societal profit of sixteen euro cent per kilometre. On the other hand, every car makes a societal loss of ten euro cent per driven kilometre. During the rush hours the societal loss for car transportation is even twenty euro cent per kilometre (COWI, 2010).

The bicycle has also some individual disadvantages (figure 1.9).
PART A - THESIS PLAN - THE LOST CYCLIST

SOCIETAL ADVANTAGES OF THE BICYCLE:
1. The bicycle does not take up much space. Cycling improves the flow of traffic in dense urban areas.
2. Cycling is, like walking, the most sustainable way of transport as this way of transport has no direct polluting or noise emissions.
3. Cycling is deeply integrated in the Dutch culture: almost all Dutch have a bicycle. No subsidy is needed for purchasing one (like in case of the car).
4. Cycling improves the public health.
5. The investment to facilitate bicycle use is far lower compared to alternative transportation modes.
6. Cycling is profitable: cycling yields 0,16 euro cents per kilometre. Other transportation modes, like the car, make a loss of -10 euro cents during the off-peak hours and -20 euro cents during the peak hours.

INDIVIDUAL ADVANTAGES OF THE BICYCLE:
1. Cycling is a cheap form of transportation. Once you have a bicycle you can go anywhere.
2. Cycling can improve the individual health.
3. Cycling is flexible and sometimes even faster than other transportation modes, especially in urban areas. Cyclists are not fixed to travel schedules and can avoid traffic jams.
4. Cycling has besides its practical function as transportation often a high recreational value.

INDIVIDUAL DISADVANTAGES OF THE BICYCLE:
1. The average speed of cycling is limited to 20 km/h. However, the new electric bicycle is becoming more and more popular under young working people. In the future the average speed of cycling can go up to 30 km/h.
2. The luggage opportunities on the bicycle are limited. But innovations, such as the Dutch ‘bakfiets’, provide enough space to carry all sort of loads.
3. Cycling is strongly weather dependent. However, in Asia it is very much common to cover the pedestrian and cycling roads in dense areas. It is imagine-able to apply this in Europe too.
4. The bicycle is uncomfortable when wearing skirt or suit to work. Providing a changing or refreshing facility at work would be enough to solve this issue.
5. The bicycle always needs to be stored somewhere: this could lead to chaotic street scene. This issue could easily be solved by providing parking facilities in dense areas.

Fig. 1.7 Conceptual scheme of the transport modes of bicycle (Interpretation from Bertolini et al., 2003)

Fig. 1.8. Societal and individual advantages of cycling (COWI, 2010; Fruianu et al, 2009; Heinen, 2011; Hendriks, 2011; Old Kalter, 2007)

Fig. 1.9. Individual disadvantages of cycling
1.5 The additional value of cycling to train commuting

Cycling proves to be very popular in the Netherlands, not only for doing shopping or recreational purpose. A quarter of all movements is made by bicycle. The bicycle is also used as transport from home to work. Of all commuter traffic is at least 25 percent by bicycle. During rush hours there are more than three million cyclists on the road. Almost 40 per cent of these bicycle trips are multi-modal journeys, using the bicycle in combination with the train (MON, 2007).

Now the international emission goals have to be achieved, clean transportation modes get more in the picture. Recently, the Dutch government is cutting back on local public transport such as tram, metro and bus. This forces people to find an alternative way of transportation. On city level the bicycle is the most clean and flexible solution.

Cycling has a very good door-to-door connection (see figure 1.10). A main advantage of cycling is that it proves to avoid traffic congestion. Cycling can even improve the flow of traffic in very dense urban areas. Areas with peak traffic could benefit a lot from cyclists. On local scale, bicycle transportation even competes with public transportation. The investments for bicycle use are far lower compared to other transport modes. Cycling is even profitable. (COWI, 2010)

A disadvantage of this active transportation mode is that is has a certain limitation in distance. Cycling mainly occurs on the local and small regional scale. The distance limitation could possibly stretch up a little more in the future with the upcoming electric bicycle. People mainly choose for cycling while it is the fastest option compared to other transportation modes. For distances more than 7.5 kilometre people rather not use their bicycle and choose for another transport mode.

On the other hand, the train has a very wide spatial reach which even goes beyond the country borders. Though, the door-to-door connection of train transport is quite poor. The combination of bicycle and train transport offers a lot of opportunities. The train transport enlarges the spatial reach, while the bicycle provides a excellent door-to-door connection. For this reason the mode combination of bicycle and train is very potential.

Combining the bicycle with the train has some other advantages besides that the train enlarges the catchment area of the bicycle transport. Good cycling conditions prove to make cities attractive (COWI, 2010).

The environment will profit from the positive effects of more people choosing the bicycle instead of the private car: less air and noise pollution, more space in public space and traffic. Finally, when people rather prefer to the take bicycle instead of a bus, tram or metro, the society will profit from that since these forms of public transport are highly subsidised.

Cycling and train transport are often used as combination by commuters to travel from home to work. This makes the bicycle network from home to the railway station of major importance. The combination of bicycle and train will become even more important in the future (NS Poort, 2011).
Fig. 1.10 Conceptual comparison between different transport modes. (Interpretation from Bertolini et al., 2003)

Fig. 1.11 The importance of cycling and walking for all train journeys (MOA, 2011).

Fig. 1.12 The importance of cycling as access mode and walking as egress mode (MOA, 2011).
Around the railway station more transport modes play a role. The combination of walking and cycling covers the greater part of all access and egress modes of the train journeys (see also figure 1.11 and 1.12).

An analysis of the various modes of access and egress to and from the train station brings the importance of walking and cycling clearly forwards. (see figure 1.3). More than half of the people leaving the station go by foot. It is interesting to consider that whatever transport mode you choose, you always begin and end as a pedestrian. In fact, everyone leaves the station as pedestrian in the first instant, to continue the journey by the same or another transport mode.

The major egress mode from the railway station, walking, has already been investigated by Inoek Brouwer in Fixing the Link (Brouwer, 2010). This lead to a validation tool to improve the link from the railway station to the city centre for pedestrians.

More than 42 percent of all train commuters arrive at the railway station by bicycle. That is, every single weekday 200.000 people who cycle from home to the railway station to take the train to their work. Logically, the public space on the way from home to the railway station is very important. But the main access mode from home towards the railway station, cycling, has never been part of research so far.

1.6 The Weak Bicycle Network

Since the railway station has developed itself the last decades as a major hub between the cities it has responsibilities as major gateway to other cities that are connected to the railway network. The railway station has become a multi-modal node where all different transport pass: buses, trams, cars, taxi’s, pedestrians, cyclists. Many commuters use the bicycle as access mode to reach the railway station.

Bicycle commuters spend generally 12 minutes on the access to and 17 minutes on the egress mode from the railway station. Commuters who travel by bus, tram or metro as access and egress mode spend double as much time to get to and from the railway station. On average, 38 minutes are effectively spend in the train. This means that, given the total travel time, commuters spend half of that time going to and from the train station. Choosing for the bicycle as access mode decreases the time spend on access and egress mode. An easy and convenient bicycle route provides a fast access to the railway station and shortens the transfer time. This results in a decreased journey time. But instead of a comfortable and attractive journey from home to work, the link from home to the railway station is often missing.

Moreover, the bicycle route from home to the railway station is often a patchwork of uncomfortable paths, blocked roads, slow traffic lights, no-right-of-way crossings and annoying diversions through the city network. The neighbourhood, from which the commuter departs every day, is often crowded with parked cars on the road and it has mostly a poor connection to the
Fig. 1.13 Door-to-door journey in time percentages.
surrounding area. The route towards the railway station lacks comfort and many times interrupted. At the railway station area the multi-transport node is frequently a point of chaos instead of a pleasant place to be.

1.7 Problem Statement

Summarising the foregoing context results in the following problem statement:

In Dutch culture cycling is besides walking the most important way of active transportation within the cities. More than forty per cent of all train commuters arrive at the railway station by bicycle. The Dutch railway station has an increasing attraction to other cities. The combination of bicycle and train will become even more important in the future (NS Poort, 2011).

However, the cycling link from home to the Dutch railway station is missing. Dutch neighbourhoods are generally poor connected to the railway station. The bicycle route from home to the railway station is often a patchwork of uncomfortable paths, blocked roads, slow traffic lights, no-right-of-way crossings and annoying diversions through the city network. The cyclist’s view is typically not central in even the most comprehensive work on urban design (Forsyth & Krizet, 2011).

The public space for cyclists from the neighbourhoods to the railway station generally lacks comfort and is many times interrupted. At the railway station area the multi-transport node is frequently a point of chaos instead of a pleasant place to be.

Cyclists and pedestrians are left over to its fate. Public space, infrastructure and public transport should work together to solve the mobility issue since sustainable urbanism and sustainable mobility are inseparable (Venhoeven, 2011).
Fig. 1.14 Problem statement scheme: Uncomfortable and incoherent bicycle network
2. OBJECTIVES

2.1 Main objective

The bicycle network between home and the railway station is often lacking comfort. The railway stations are surrounded by motorised traffic while the neighbourhoods are often in particular designed for living plus one or more cars. A more correct and respectable treatment of the cyclist in the urban environment seems desirable. Active transportation, like cycling, makes cities liveable and attractive. That could not be said about the car.

The main objective of the thesis is to develop spatial design interventions to create a comfortable and coherent bicycle network that strengthens the bikeability from home to the Dutch railway station. From literature study and case study analysis an approach method will be evolved that will improve the bicycle network from home to the railway station area.

The further objective of this project is to use the criteria for developing successful public space from the perspective of the cyclist and use the conclusions resulting from the case studies to make spatial design interventions for one of the locations chosen during the case studies.
Fig. 2.1 Making a comfortable and coherent bicycle network
3. RESEARCH QUESTIONS

This chapter discusses the research questions of the graduation project. First the main research question is presented and further on the three sub research questions are presented.

3.1 Main Research Question

The main research question of the graduation project is:

What spatial design interventions can create a strong, consistent and attractive bicycle network to strengthen the bikeability from home to the Dutch railway station?

This research question mentions the bicycle network framed by the home and the Dutch railway station. This focus points needs a further explanation.

3.2 Defining the Bicycle Network

In the introduction of the graduation project the problem of the incoherent and uncomfortable bicycle network from home to the railway station is addresses. Home and the railway station are pointed out as the starting and ending point of the bicycle route. The ending point of the railway station has a specific point while it exists of one building. But what is the starting point home exactly?

Home as starting point is a somewhat vague conception as shown in figure 3.1. It is ‘the place where someone lives’ and does not define a specific place (Oxford Online Dictionary, 2011). Since the graduation project does not focus on one home in specific it is desirable to talk about a starting area, the direct living environment, instead of one starting point.

The starting area is for this graduation project when the bicyclists leave the neighbourhood and enter the speed bicycle route. As Figure 3.2 shows the speed bicycle route and the railway station area contain a significant amount of commuting cyclists, the target group for this project.

In order to analyse the bicycle network, the graduation project makes a distinction in the transition area towards the ending point. Unlike with home, the railway station is one clear end point, but as part of the network it is more relevant to talk about the railway station as entity.

Starting from home, the first thing that occurs in a neighbourhood are parked or slow going cars, most of the times in a 30 km/h zone. When you leave the neighbourhood the maximum speed rises up to 50 km/h and there happens to be more traffic lights and faster going cars. You enter the railway station area by ‘cycling access street’. From the corner of this street the railway station is in sight. Then you approach the railway station, you park your bicycle, pass the busy station square and enter the station. The bicycle route can be divided in three parts as can be seen in Figure 3.3:

1. **Neighbourhood** (as network entity)
2. **Speed bicycle route** (as linear route)
3. **Railway station area** (as network entity)
Fig. 3.1 The starting point (home) is unclear.

Fig. 3.2 Conceptual graphic that shows the significant part of the bicycle route that is analysed in this graduation project.

Fig. 3.3 The route divided in three parts, (1) direct neighbourhood, (2) speed bike route and (3) the railway station area. The neighbourhood is excluded in case study research.
3.3 Defining the conditions for successful public space for cyclists

In order to answer the main research question of the graduation project, there are three sub research questions formulated. The main research question addresses a strong, consistent and attractive bicycle network. First we need to define what the criteria for successful public space for cyclists are.

Therefore, the first sub research question is:

1. What are the conditions for successful public space for cyclists to strengthen the bikeability from home to the Dutch railway station?

3.4 Applying the conditions for successful public space for cyclists

After the conditions for successful public space for cyclists are defined we need to know how the conditions are applicable, to test the current quality of the bicycle network from home to the Dutch railway station.

The second sub research question is:

2. How are the conditions for successful public space for cyclists applicable, to test the quality of the bicycle network from home to the Dutch railway station?

3.5 Analysing the state of the current bicycle network

When we know what the conditions for successful public space for cyclists are, we have to study the quality of the current bicycle networks in the Netherlands. Comparable cases will be checked with the conditions for successful public space for cyclists. Moreover, conclusions will be drawn on the basis of these analyses.

The third sub research question is:

3. What is the current quality of the bicycle network between the Dutch home and the railway station in comparable case studies in the Netherlands?

3.6 Applying the Criteria in Spatial Design Interventions

Last but not least, the list of conditions for successful public space for cyclists and the conclusions from practice result to a spatial design for one of the cities. One of the cities from the case studies with a low score will be chosen to work out in a design to strengthen the bicycle network from home to the railway station. The fourth and last sub research question is:

4. How are the conditions for successful public space for cyclists and the conclusions resulting from the case studies usable in a spatial design for the city?
The answers of the three sub research questions altogether leads to the answer of the main research question of the thesis (see figure 3.4).

In the next chapter the methodology of the graduation project will be discussed to be able to tackle all these questions.

Fig. 3.4 Schematically approach of the research questions
4. METHODOLOGY

This chapter explains the methodology of the thesis by addressing every sub research question. On the preceding page you can see a scheme of the methodology of this thesis (figure 4.1). Each of the sub research questions have a direct connection with the intended end products of the graduation project. In the following sections, with every question is explained which end product is the outcome.

From literature study and case study analysis a set of criteria will be developed. These criteria will lead to a method tool that will be used for the case studies to measure the bicycle network from home to the Dutch railway station. After the case study has been finished a choice will be made for one of the cities to be worked out in a spatial design in which the criteria of the validation tool will be applied.

4.1 Approach of defining successful public space for cyclists

The first sub research question (What are criteria for successful public space for cyclists applicable to strengthen the bikeability from home to the Dutch railway station?) is addressed by studying literature on the quality of public space for cyclists. This results in a paper, which is one of the required end products of the graduation project.

The aim of study is to create a list of criteria for successful public space for cyclists. The literature used for this study explores the different views on (design of) successful public space for cyclist. Both authors from the field of urban design and authors who attempt to combine the urban design with the transportation engineering are discussed. The study starts with a summary of the work. At the end a list of criteria for successful public space for cyclist is created. Finally the applicability of the criteria to strengthen the bicycle network from home to the railway station is discussed. The results of this literature study are discussed in the paper ‘Successful public space for cyclists’ for the course AR3012 Theory of Urbanism.

4.2 Approach of applying the conditions for successful public space for cyclists

The second sub research question (How are the conditions for successful public space for cyclists applicable to test the quality of the bicycle network from home to the Dutch railway station?) is considered by combining the conclusions from the literature study of sub research question one with the first results of the case studies of sub research question three.
Sub RQ #02.

Applying the conditions for successful public space for cyclists:

- How are the conditions for successful public space for cyclists applicable to test the quality of the bicycle network from home to the Dutch railway station?
- Result: Manual -> evaluation tool
- Method: Design an evaluation tool based on results of literature review and tested in case study research in Sub RQ #03.

Sub RQ #03.

Analyzing the current bicycle network:

- What is the current quality of the bicycle route between the Dutch home and the railway station in comparable case studies in the Netherlands?
- Result: Atlas -> case study analyses
- Method: Case study research based on the evaluation tool of Sub RQ #02.

Spatial design interventions fixing the bicycle network between home and the railway station

Fig. 4.1 Methodology approach
In order to make the conditions usable in practice there are a few requirements how to describe them:

1. **What**: the condition is shortly set out.
2. **Why**: the condition is proved by means of literature.
3. **How**: the execution of how the conditions can be measured is set apart.

The results are combined in a manual that elaborates how the evaluation tool can be used to test the quality of successful public space for cyclists (see Appendix B).

### 4.3 Approach of analysing the current bicycle network

The third sub research question (What is the current quality of the bicycle network between the Dutch home and the railway station in comparable case studies in the Netherlands?) is answered by a case study research based on the results of the literature review (figure 4.3). This research is also a required end product of the graduation project.

The conditions from the first sub research question are used in a case study research to make a method approach for the quality of the bicycle network between home and the railway station. Since the bicycle network exists of different urban elements, a distinction is made in three parts as follows:

1. **Neighbourhood**: since ‘home’ is no specific point in a city, the border of the neighbourhood is the starting point of the route to the railway station in this research.
2. **Speed bicycle route**: the linear cycling link in between the neighbourhood and the railway station.
3. **Railway station area**: you enter this area when passing the corner of the ‘cycling access street’ and the railway station is in sight and you are within 500 metres distance from the railway station.

The case study research will be done according to the three urban areas above. The first step in the case study research is to choose what bicycle routes will be analysed. This choice is made together with NS Stations on the basis of three grounds. In the first place the cities of choice should be part of the NS top 50 ranking of stations in the Netherlands. To make the case study research comparable the smallest and biggest stations were not selected.

The second criteria is that the city of choice should have a major amount of bicycle commuters, cycling every day from home to the railway station.

In the last place the cities should be comparable with the design location Amsterdam Amstel. Dordrecht is an exception.
### Figure 4.4 Selected case studies

<table>
<thead>
<tr>
<th>#</th>
<th>Selected bicycle route goes from neighbourhood...</th>
<th>...to railway station:</th>
<th>This bicycle route is selected on the basis of:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>#Bicycle commuters:</td>
</tr>
<tr>
<td>1</td>
<td>Rivierenbuurt</td>
<td>Amsterdam Amstel</td>
<td>++</td>
</tr>
<tr>
<td>2</td>
<td>De Pijp</td>
<td>Amsterdam Amstel</td>
<td>++</td>
</tr>
<tr>
<td>3</td>
<td>Oosterparkbuurt</td>
<td>Amsterdam Amstel</td>
<td>++</td>
</tr>
<tr>
<td>4</td>
<td>Watergraafsmeer</td>
<td>Amsterdam Amstel</td>
<td>++</td>
</tr>
<tr>
<td>5</td>
<td>Betondorp</td>
<td>Amsterdam Amstel</td>
<td>++</td>
</tr>
<tr>
<td>6</td>
<td>Emerald (Delfgauw)</td>
<td>Delft</td>
<td>++</td>
</tr>
<tr>
<td>7</td>
<td>Tanthof-West</td>
<td>Delft</td>
<td>++</td>
</tr>
<tr>
<td>8</td>
<td>Regentessekwartier</td>
<td>Den Haag HS</td>
<td>++</td>
</tr>
<tr>
<td>9</td>
<td>Oud-Rijswijk (Rijswijk)</td>
<td>Den Haag HS</td>
<td>++</td>
</tr>
<tr>
<td>10</td>
<td>Dubbeldam Noord</td>
<td>Dordrecht</td>
<td>--</td>
</tr>
<tr>
<td>11</td>
<td>Dubbeldam Zuid</td>
<td>Dordrecht</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: The values in the table indicate the level of selection for each criterion (e.g., ++ indicates a high level of selection).
on the second rule, since the city has an underaverage amount of cyclists. But this city offers a new solution for bicycle parking storage and is one of the few cities in the top 50 ranking without a restricted bicycle parking capacity.

For every city at least two bicycle routes are selected. Each route enters the station from a different direction. The selected bicycle routes should be part of the major bicycle commuters flows from the neighbourhoods to the station. For Amsterdam Amstel five bicycle route are selectes, since this city was part of the workshop and the design assignment. In Dordrecht two main bicycle route from the direction of one neighbourhood is selected. However the bicycle route departs from the same neighbourhood, the routes develop totally different. The table in figure 4.4 below shows for each city of the case study research, which bicycle routes are chosen and on what grounds.

As a start, the case study research begins with the test case of Delft. This case study is used as development case to adjust the conditions in practice. The evaluation tool for successful public space is applied on the selected urban areas. Each location is visited and captured by photos, sketches and notes. The result of the evaluation tool is summarised in a pyramid scheme which is used to compare with the other bicycle routes. The results of the case studies are published in an atlas, in part C of the ReCYCLE City booklet series, in which all case studies are assembled.

4.4 Approach of applying the criteria in spatial Design Interventions

The fourth and last sub research question (How are the conditions for successful public space for cyclists and the conclusions resulting from the case studies usable in a spatial design for the city?) is answered by making a spatial design for one of the cities. The design is the last requirement of the graduation project.

From the series of case studies, one city will be selected to work out in detail. The selection will take place after the analyses are done. The location of choice will be a city with a low score for quality of public space. Currently, station area Amsterdam Amstel, and the route from neighbourhood Betondorp seems a suitable design location. The municipality has announced to redevelop this station area soon. And NS Poort confirmed that this location would be interesting for creating a design.

The conditions from the literature study and the conclusions from the case studies are used as starting point for the design assignment. Making the design is a continuous process of visiting the site, sketching, making more photos and notes and making maps and 3D models (see figure 4.5).
Fig. 4.5 Methodology approach for sub research question #04
4.5 Interrelationship Research Questions

The first sub research question is addressed by a literature study on the quality of successful public space for cyclist. At the same time, sub research question two is derived with the use of the literature study and the first results from the case study research. This results in a method tool described in the Atlas handbook. The third sub research question uses this handbook with the conditions for successful public space for cyclist to apply in case study research. It results in an Atlas of all case study research.

The fourth and last sub research question gets the input directly from the case study research and the literature study, the paper. By means of the method tool, the research study shows the weakest link of the bicycle network and a city in which the design assignment is very urgent. The design also includes significant findings from literature study and case study research that are not directly adaptable in a method tool.

Finally, the result of the answers to the four sub research questions is spatial design interventions to improve the bicycle network from home to the railway station. This answers the main sub research question of the thesis.

4.6 Results

The results of the first sub research question is a theoretical framework, based on literature review, present the spatial conditions for successful public space for cyclists. The outcome of the second sub research question is presents an evaluation approach from which the conditions are applicable for the cities in the case study research. This is done by means of the paper conclusions and case studies. The third sub research question results in an Atlas in which the manual is used to test the series of cities for case study research. The fourth and last sub research question combines the results of the literature and case study research in a design proposal. The design will combine all findings to realise an optimal bicycle network from home to the railway station, taking into account all user groups.
5. RELEVANCE

5.1 Academic relevance

Currently there is a gap of knowledge in the way urban planners and designers can contribute in making a comfortable urban environment for cyclists. Urban designers tend to focus on pedestrians in specific. The work of transportation planning focuses on the motorised vehicles in which cyclists pose potential conflicts. The cycling researchers address the importance of promoting safety and providing continuous bicycle networks. “The cyclist’s view is typically not central in even the most comprehensive work on urban design” (Forsyth and Krizet, 2011, p.533).

This thesis starts to fill this gap in urban design by sketching out current practice. This is done by offering a framework and other tenets to consider in understanding the experience of cyclists, and providing preliminary design recommendations.

5.2 Societal relevance

The societal relevance of this research lays in the fact that it is focussed on the way urban planners and designers can contribute in making a strong and attractive bicycle network to the railway station area. An urban environment for cyclists stimulates the use of active transportation and increases the liveability of the city. Good cycling conditions create attractive cities (COWI, 2010). Cycling has a lot of other advantages. First of all, cycling is a cheap form of transportation and is healthy while it prevents you from all kinds of diseases. Cycling offers above all flexibility to move whenever and wherever you want to go and often has a high recreational value. And sometimes even faster than other transportation modes. The last point proves to be one of the main reasons for people to take the bicycle.

Next to these individual advantages there are also several advantages of which the society benefits; cycling does not take up much space. Besides walking, cycling is the most sustainable way of active transportation while it has no direct emissions. Another advantage is that cycling is part of a common Dutch habit. Almost everyone has a bicycle and cycling improves the public health. More importantly, a relative small investment is needed to facilitate bicycle use compared to other transportation modes.

Last but not least, cycling even generates profit. Research by the Danish government pointed out that a cyclist makes a societal profit of sixteen euro cent per kilometre. On the other hand, every car makes a societal loss of ten euro cent for per driven kilometre. During the rush hours the societal loss for car transportation is even twenty euro cent per kilometre.

Combining the bicycle with the train has some other advantages besides that train enlarges the catchment area of the bicycle transport. The environment will profit from the positive effects of more people choosing the bicycle instead of the private car: less air and noise pollution, more space in public space and traffic. Finally, when people rather prefer to take bicycle instead of a bus, tram or metro, the society will profit from that since these forms of public transport are highly subsidised.
5.3 Ethical relevance

The ethical relevance of this research lays in the perspective of added value cyclists have on the public goods. Cycling is a clean and free mode of active transportation. In the car dominated world in which we live, non-polluting transport modes are desirable. More cyclists means a cleaner and more attractive living environment. In the Netherlands almost everyone has a bicycle.

Second, during the current cutback in expenditures by the government car infrastructure is a costly business. Cycling infrastructure per kilometre is ten times cheaper compared to an investment for a kilometre of car infrastructure.

Summarising, we can conclude that in combination with public transport, cycling provides a transport system that is accessible for everyone.

5.4 Disciplines

The discipline involved in this project are Spatial Planning and Strategy (mentor Remon Rooij). Second, the discipline of Urban Design and Design of Public Space is included (mentor Stefan van der Spek).

The third important actor involved in the project is NS Poort, the real estate division of the Dutch Railways (mentor Sebastiaan de Wilde).
This part addresses the first sub research question of the thesis: “What are the conditions for successful public space for cyclists to strengthen the bikeability from home to the Dutch railway station?” This question is answered by a literature review of leading authors in the quality of public space for pedestrians and cyclists.
6. CONDITIONS FOR SUCCESSFUL PUBLIC SPACE FOR CYCLISTS

6.1 Introduction

In Dutch culture, cycling and walking are the most common ways of active transportation within the city (Heinen, 2011). Nowadays, more than forty percent of all train passengers arrive at the railway station by bicycle. Every weekday 1.2 million travelers use the bicycle to go to the station. And it is estimated that the combination of bicycle and train will become even more important in the future (Venhoeven, 2010). But the spatial quality of the bicycle network from the Dutch residential neighbourhoods to the railway station is often poor: uncomfortable and incoherent. Urban design might and should bring solutions. Unfortunately, the cyclist’s perspective is under-represented in even the most comprehensive work of urban design (Forsyth & Krizek, 2011).

This part addresses the first sub research question of the thesis: “What are the conditions for successful public space for cyclists to strengthen the bikeability from home to the Dutch railway station?” This question is dealt with by means of a literature review that critically assesses a number of leading authors in the field of the design and planning of public space. This results in a conceptual framework for successful public space for cyclists that focuses on safety, directness, comfort and attractiveness. The chapter starts with the theory of Jan Gehl (2010), which leads to a conceptual framework for successful public space for cyclists (Van Hagen, 2009; Maslow, 1943). The conceptual framework is fine-tuned by means of an overview of literature of the well-known work on the quality of public space for pedestrians (Cullen, 1961; Jacobs, 1961; Lynch, 1961) and for cyclists in particular (Bach, 2006; Borgman, 2006; EC, 1999; Ewing & Handy, 2003; Rietveld & Daniel, 2010; Forsyth & Krizek, 2011). Then theory and practice are both translated into design recommendations.

The result of this literature review is a list of conditions for successful public space for cyclists and sets the base for a benchmark for successful urban environment for cyclists. It can be used to test the quality of bicycle networks in practice (Scheltema, 2012).

6.2 A conceptual framework for successful public space for cyclists: the Pyramid of Needs

The theoretical base for the conceptual framework starts with Gehl's theory on successful pedestrian landscape. In his book ‘Cities for People’ Jan Gehl (2010) sees cities as meeting places. He stresses that public space should always be approached from the human dimension, with attention to the sense of place, scale and dimension. According to him, this view is in many cities neglected the past decades. He points out that better conditions for public space create a better city life. As main example he uses Copenhagen.

Gehl argues that there are three quality factors that form the base for a successful pedestrian landscape: protection, comfort and delight. All criteria contribute in creating good quality of city life. Figure 6.1 shows these quality factors, elaborated in a list of twelve quality principles for achieving this successful pedestrian landscape.
The 12 quality criteria for successful pedestrian landscape

1. **Protection**
   - Protection against traffic and accidents – feeling safe
   - Protection against crime and violence – feeling secure
   - Protection against unpleasant sensory experiences (rain, snow, pollution, noise, etc.)

2. **Comfort**
   - Opportunities to walk (room for walking, good surfaces, etc)
   - Opportunities to stand/stay
   - Opportunities to sit
   - Opportunities to see (reasonable viewing distances, interesting views, lighting when dark)
   - Opportunities to talk and listen
   - Opportunities for play and exercise

3. **Delight:**
   - Scale (buildings and spaces designed to human scale)
   - Opportunities to enjoy the positive aspects of climate
   - Positive sensory experiences (good design, materials, trees, plants, water)

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Fig. 6.1 Gehl (2010, p. 238-239)

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Fig. 6.2 The Pyramid of Requirements for Pedestrian Landscape (Interpretation of Gehl, 2010, p.238-239)
The first criterion - protection - is the basic element. If a place is not safe, the other qualities are meaningless. The second criterion - comfort - is to ensure the place offers good opportunities to move through and stay at a place that is inviting people to be used. The third and last quality factor - delight - makes the place complete. Figure 6.2 shows this subdivision in a hierarchic pyramid.

Gehl’s theory tell us that the quality of a place can be considered in terms of protection, comfort and delight. The principles of dividing the criteria in such a way dates back from earlier research in the field of psychology: the hierarchy of human needs. This chapter discusses the origin of the human needs hierarchy approach and how it can be translated into a hierarchy of quality criteria for public space for cyclists.

The origin of Gehl’s quality criteria descends from psychological research in the 1940’s. In the paper ‘A Theory for Human Motivation’ Maslow (1943) describes the psychological and physical needs of the human being. He portrays these needs in a pyramid which he names the ‘Pyramid of Needs’ as shown in figure 6.3. Maslow introduces ‘deficiency needs’ (or D-needs) that form the basic four needs of the pyramid. The most fundamental need is shown in the grey bottom of the pyramid. If these physiological needs - air, food, water, shelter et cetera - stay unmet a human being simply is not able to function. The other three needs - safety, love and esteem - can only be fulfilled if the physiological needs are met. The top of the pyramid - self-actualisation - contains the ‘being need’ (or B-needs) represent the need of becoming everything that one is capable of becoming. In order to reach this need all four ‘deficiency needs’ should be fulfilled.

Maslow’s theory has proven to be useful in other research fields too. It has been used in marketing studies to understand the needs of customers. Van Hagen (2006) used Maslow’s pyramid of needs for his study in customer needs at railway station platforms. Figure 6.3 shows that he translated the requirements of customers in a pyramid of customers needs. Instead of using the so called deficiency and being needs of Maslow, he introduces other definitions.

Van Hagen’s pyramid for customer needs was developed together with the Dutch Railways (‘Nederlandse Spoorwegen’) in order to optimize the waiting experience of the customers at the Dutch stations and it is often applied in practice. This pyramid is based on the theory of satisfiers and dissatisfiers. Van Hagen emphasises that people have a basic needs for doing or using something. Safety and reliability are the first essential requirements for customers. The second and third basic conditions are ‘ease’ and ‘speed’. These time aspects become of more importance when people are moving from one place to another. When these basic conditions stay unmet, the service is of very little value. Van Hagen calls these first three criteria the ‘dissatisfiers’. These ‘dissatisfiers’ are the ‘must haves’, the precondition for the ‘satisfiers’. The conditions that belong to this second group according to Van Hagen are ‘comfort’ and ‘experience’. These ‘satisfiers’ can only be fulfilled if the ‘dissatisfiers’ are met. When that is the case, the service will be valued even more positive.
Fig. 6.3 Pyramid of Human needs (left) (Maslov, 1943: 370-396) and Customers Needs (Van Hagen, 2009: 10-11)
6.3 Existing body of knowledge on successful public space for cyclists

In the existing literature, four conditions are distinguished that describe successful public space for cyclists: safety, directness, comfort and attractiveness. The following chapter discusses the work of various authors and organisations in the field of urban planning and traffic engineering that sets the base for the list of conditions for successful public space for cyclists.

6.3.1 Safety

Gehl’s so called ‘protection’ is illustrated by what the European Network for Cycling Expertise (ECF, 2003) put forward. They state that people are not willing to cycle unless the public space is safe. They conclude that safety is the precondition for the overall appreciation of public space. Furthermore, they emphasise the need of good cycling facilities such as bicycle parking in city centres, stations and schools.

The Dutch Cyclist Union (Borgman, 2003) is a second example of an organisation that did research on the quality of public space for cyclists. By means of a literature study and a lot of field studies, the Dutch Cyclists’ Union states that the bicycle should be competitive with other transport modes (Borgman, 2003). In terms of time, safety and comfort and attractiveness. To test the bicycle network of a city, they developed a measuring tool called the ‘Cycling Balance’ that incorporates all the conditions. This tool also includes the local policies and the cycling satisfaction. Figure 6.4 shows the result of an analysed city represented in a Cycle Balance scheme. The approach by the Cyclist Union corresponds with all the conditions of Gehl - protection, comfort and delight.

Additionally, they also address ‘time’ by mentioning that the bicycle network should be direct and coherent. Gehl’s ‘delight’ condition is also considered by the Dutch Cyclist Union in terms of ‘attractiveness’ of public space.

Forsyth and Krizek (2011) emphasise that the network and layout are preconditions for good public space for cyclists. In their scheme they show their special attention to safety, coherence and directness of the bicycle network (Figure 7). Furthermore they address the importance of good bicycle parking facilities and detailed design of public space.

The fundamental need for safety is confirmed by the European Commission (1999) responsible for the environment. They published their research in a booklet ‘Cycling: the way ahead for towns and cities’. This organisation devotes itself to the promotion of cycling in the European Union. Ritte Beggejaard, researcher at this committee, emphasises the significance of providing well-designed safe street for cyclists (EC, 1999). He shows the many individual and social benefits of cycling in terms of economic profit, health and quality of the environment. Like the other organisations, they also mention the importance of directness of the bicycle network.

6.3.2 Directness

Gehl (2010) approaches good quality of city life by means of four key objectives: lively, safe, sustainable and healthy. For a lively city it is important that there are logical routes, meeting places and a clear city hierarchy. Lively cities also need an active ground floor plan and activities on the edges. Safe cities provide more city life and are therefore desirable.
The cycle route quality requirements:

| Consistency                  | • coherent route  
|                             | • connected route  
|                             | • legible route    |
| Directness                  | • short route     
|                             | • direct route    |
| Attractiveness:             | • well designed cycling infrastructure  
|                             | • good lighting   
|                             | • presence of shelter 
|                             | • clear signage   
|                             | • short waiting time at crossings |
| Road safety                 | • separate cycling tracks  
|                             | • smooth pavement   
|                             | • lighting         
|                             | • removal of dangerous junctions  |
| Convenience                 | • smooth and convenient traffic flow  
|                             | • smooth and skid-resistant pavement |
|                             | • no steep slopes or long stretches slightly sloping pavement |
|                             | • stay clear off walls or busy traffic arteries |

Fig. 6.4 Cycle Balance score of Veenendaal (Borgman, 2003, p. 5)

Fig. 6.5 Cycle route requirements by Bach (2006, p. 250)
Urban designer and traffic engineer Bach (2006) studied for decades on the relation between the design of traffic infrastructure and public space. In the book ‘Urban Design and Traffic, A Selection from Bach’s Toolbox’ he provides a list of guidelines for bicycle route quality, as shown in figure 6.5, that is developed together with CROW (the ‘National Knowledge Platform for Infrastructure, Traffic, Transport and Public Space’ in the Netherlands). They state that public space for cyclists should be consistent and direct. The bicycle network should be coherent, connected, legible, short and direct.

With his book ‘The Concise Townscape’ Gordon Cullen (1961) belongs to the first group of authors who approached public space from the perspective of the pedestrian. With sketches and photos Cullen shows what people see when they walk through a network of public spaces. Cullen mainly focuses on the physical dimension of public space. Figure 6.6 shows that Cullen draws a diversity of views of streets, squares, courts, alleys, gateways and the different experience of designed details and landmarks from several distances. They provide a first insight in the ‘mind mapping’ of a city. Hereby, Cullen stresses the importance of a legible and direct route.

Kevin Lynch (1961) also belongs to this first group of architects and urban designers. With his book ‘Image of the City’ he addresses the ideas that every human being has the need to recognise and pattern the surrounding they are in. According to Lynch the city should have a clear image; it should be legible with a clear city structure (paths, edges, districts) and by providing meaning and identity to places (nodes and landmarks). Figure 6.7 shows how the ‘Image of the City’ provides insight in the legibility of the city by distinguishing these five key elements in the city: paths, edges, districts, nodes and landmarks.

Lynch’s work builds on the study of Cullen by considering all users of public space instead of only pedestrians. A difference between Cullen’s work is that Lynch does not draw conclusions on the relation between physical and visual quality of public space.

Forsyth and Krizek (2011) use the theory of the previous authors in ‘Urban Design: Is there a Distinctive View from the Bicycle?’ which discusses the differences and similarities in urban design approaches based on cyclists, motorized vehicles and pedestrians. They state that the cyclist’s view is typically not central in even the most comprehensive work on urban design. Forsyth and Krizek conclude that there should be a more radical reconceptualization of urban design given the speed, height, exposure, lighting requirements and parking needs of cyclists. The authors share the view of Lynch that a city network should be clear and legible. Moreover, they point out that facilities and the design of the public space can very much contribute to the physical comfort and mental experience of a place. Forsyth and Krizek summarise the theory of Lynch in a conceptual framework. Figure 6.8 shows their set of four key dimensions for urban design from the perspective of the cyclist. Forsyth and Krizek provide an understanding of the common and different interests of cyclists, pedestrians and motorised vehicles in public space. The paper gives design recommendations, but remains too superficial to be used as a design tool.
Four key issues to create a urban design that satisfies the needs of cyclists:

1. **Networks & layout** should be seamless and continuous and it should be taking into account that cyclists have various skills and speeds.

2. **Facilities** should be appropriate to the level and place in the network.

3. **Processes** should be adjusted to the cyclist’s experience of today and tomorrow, including the expertise fields of transportation and urban design.

4. **Detailed design** should be considered from the experience of the built environment at a speed beyond the pedestrian but slower than the car, with adapting the physical and social needs of the cyclists.

Fig. 6.8 Key dimensions of Forsyth and Krizet for urban design that fits the needs of cyclists (Forsyth and Krizet, 2011, p. 544-545)
6.3.3 Comfort

Urban designer and traffic engineer Boudewyn Bach (2006) presents the idea that public space needs human scale and should always fit the slow mode traveller. And he emphasises that urban design should always take the lead in the interdisciplinary design process.

Bach combines his knowledge from his study in urban design and traffic engineering by creating a design toolbox consisting of four layers: patterns of land use, networks of connections, spaces in which everything occurs and siting locating of activities within these places. Each of the four layers consists of different icons that explain the urban structure of the urban design.

With this tool he attempts to show the weak and strong points of various case studies and stresses the relation between the spatial characteristics and a certain transport mode. Bach gives in his book special attention to cycling in the urban environment. Figure 6.9 shows a list of eight design guidelines he composed that should fit the needs of slow traffic:

Bach’s ‘Toolbox’ provides a detailed insight in the design methods of public space with special attention to urban design and traffic planning. He gives an overview of the different design styles, tools and processes that exist. By means of a design tool he strives to explain the essence of various example projects and the different needs of the participants in public space.

Bach translates the physical needs in public space to a set of design instruments. He also pays attention to pedestrians and cyclists and composes a design tool for slow traffic. Bach even compiles a list of cycle route quality requirements. But in his book he only addresses the physical aspects of public space. The visual aspects are less discussed.

Economics Rietveld and Daniel (2010) did research commissioned by the Free University of Amsterdam. They provide insight in the decision-making of people choosing for cycling. By analysing the determinants in cycling, the authors attempt to find if and how national and local policy making can influence bicycle use. Figure 6.10 shows the general framework that explains the needs of cyclists.

According to Rietveld and Daniel, a good network of infrastructure and bicycle friendly policies are needed as the base for good urban environment for cyclists. If you want people to take the bicycle, the bicycle network should be safe and well-connected. The aspect of safety is considered in terms of the need for protection for injuries and for example theft. The determinants shown in the scheme consider both the element of safety and directness. In addition they also mention the need of comfort for good public space for cyclists.

Gehl (2010) emphasises that bicycles should be part of integrated transport thinking. Possibilities to combine the bicycle as access and egress mode for public transport are needed. And good parking options along streets in general and facilities such as schools, offices and shops should be part of integrated transport policy. He mentions that the possibility to park the bicycle securely at railway stations and traffic hubs is part of the need for comfort.
Design tools for slow traffic:

1. **Pattern** of land use
   - **Concentration of land use**: Clustering activities create opportunities for better amenities and generates traffic peaks.
   - **Gateway-market axes**: Activities frontages (‘urban plinth’) which enliven pedestrian routes, in turn improving urban safety.

2. **Networks** of connections
   - **Centripetal network**: Roads leading to a single point shorten pedestrian/cycle routes, but encourage congestion. Rail links to a single point make it easier to change trains.

3. **Spaces** in which everything occurs
   - **Axis and long lines**: Improves orientation. Often used with main axes for car traffic, but also with car-free axis for shopping, public transport, bicycles and/or green space.
   - **Street frontage**: Continuous frontages can lend significance to spaces and give the roadscape an urban character.

4. **Siting** of activities within these places
   - **Activities on the road together**: Pedestrians and cyclists follow the same route to the centre. This shortens routes, generated more passers-by for shops and improves public safety.
   - **Short main route**: Shortening routes stimulates permitted traffic and increases possibilities for orientation within the urban structure. Route shortening for non-motorised traffic increases public safety because of the extra activity generated (‘more pairs of eyes’).
   - **Route clustering**: Clustering makes a zone busier and safer for public. An expensive engineering structure, such as a footbridge, is then more feasible.

Fig. 6.9 Bach (2006: 42-45, 544-545)
6.3.4 Attractiveness

In ‘Cities for People’ Gehl (2010) explains the importance of the human perspective in public space. He mentions the city as a place to meet. With a lot of practical examples, the book describes twelve quality criteria for successful pedestrian landscape. Besides the focus on pedestrians, this book describes specifically the advantages of cyclists in public space.

Gehl describes various design solutions for organising and detailing public space. This is done with special attention for pedestrians and cyclists. Gehl underpins the need of cities for pedestrians and cyclists as active slow transport modes. Therefore, the quality criteria for pedestrians can also be adapted for the quality of public space for cyclists. And he emphasises the importance of combining cycling and public transport and the special attention that should be given to the urban and architectural design. Gehl states that especially pedestrians and cyclists, the slow traffic, contribute in a lively city. They take much less space than other transport modes and add greatly to an active, healthy and green public space. These active forms of transportation meet all the objectives for good quality of city life according to Gehl.

Bach (2006) stresses that the public space should be attractive with well-designed bicycle infrastructure and public space. This corresponds with the ‘delight’ criterion of Gehl. He mentions the road safety as main requirement as well. Good cycling tracks are separated, lighted, with smooth pavement and safe junctions. Bach also addresses the convenience of the bicycle route. The routes are suggested to be designed smoothly, without slopes and free of obstacles along the track. This matches Gehl’s view on ‘comfort’ in public space. Bach’s requirements of ‘consistency’ and ‘directness’ are additions to the theory of Gehl.

Jane Jacobs (1961) stresses in her book ‘Death and Life of Great American Cities’ that activity is the key condition for successful public space. Jacobs points out diversity as the most important aspect of public space. The main street and sidewalk network is seen as the essence of the existence of a city. It creates a public space where people are able to see and meet each other wherever and whenever they want. According to Jacobs the informality of these sidewalks creates diversity in a city. She explains her point of view by four rules for the urban environment. First, the district should serve at least one primary function (liveliness). In the second place, the building blocks should be short of length and frequently interrupted by side streets (human scale). Third, the buildings in the district should have a different age and appearance to stimulate the local economy. Finally Jacobs points out there should be an effective concentration of dense and less dense areas (experience). Although Jacobs mainly focuses on pedestrians, the conclusions of the book can also be taken into account for cyclists in the way they experience the districts and building blocks in public space.

In the research ‘Measuring the Unmeasurable’ Ewing and Handy (2009) provide an understanding in the relation of the built environment and the pedestrians using it. They summarised their findings in a conceptual scheme, as shown in figure 6.11, that shows the objective and subjective aspects of this relation. This corresponds with the interpretation of Gehl. The authors
Fig. 6.10 General framework of factors explaining bicycle use (Rietveld & Daniel, 2004, p. 533)

Fig. 6.11 Objective & subjective criteria for cyclists (Interpretation of Ewing & Handy 2009, p. 67)
state that the urban design qualities of public space, affected by physical features, influence the general walkability of a city. This study addresses all three conditions for successful public space according to Gehl and corresponds with the hierarchy he uses. The fundamental element ‘protection’ and ‘comfort’ matches with the physical features and the ‘delight with the urban design qualities.’

4 The development of the pyramid ‘Successful public space for cyclists’

Gehl’s list of design requirement is actually an elaboration of Maslow’s pyramid. The design criteria are divided in the same hierarchic way and are comparable with the fundamentals of Maslow’s theory. Gehl’s design conclusion that the quality of a place can be considered in terms of protection, comfort and delight has proven to be applicable also for other work. Concluding the studied work so far, we can consider four key conditions for successful public space for cyclists, as showed in figures 6.12 and 6.13. In the following paragraphs, each of the four conditions is set apart.

The condition safety corresponds with the Gehls’ ‘protection’ in the bottom of the pyramid. Safety is the most fundamental condition of the four: social, environmental and personal safety. If this condition is not met, the other conditions cannot be fulfilled and the public space will be valued as poor. Safety refers to the cyclists feeling and being safe in public space. Since cyclists are one of the most vulnerable users in public space, they need protection against motorised traffic. Cyclist should be given their own bicycle lane if possible and the pavement should be smooth. But the presence of other people, eyes on the street, is also crucial for the safety of the cyclist. And especially during night the lighting along the cycling path is important for the safe well-being of the cyclist (Bach, 2006; Borgman, 2003; Forsyth & Krizek, 2011; Gehl, 2006; Rietveld & Daniel, 2010).

The second condition of the four is directness, directly linked with the time aspect, as people have to get their train on time, and directly linked with the degree of coherence of the bicycle network. This condition is - like safety - a precondition for the ones standing higher in the pyramid. As we have learned, the coherence and consistency of the bicycle network are of main significance for the directness of the public space. Linearity, continuity and orientation of the route are also crucial. It is also important that the distance of the bicycle route from origin to destination is as short as possible. And the route can easily be followed by logical directions and signage (Bach, 2006; Borgman, 2003; Forsyth & Krizek, 2011; Lynch, 1961).

The condition comfort is the first that counts as ‘satisfier’ aspect in the pyramid. When the conditions safety and directness are fulfilled, public space is even more appreciated if this comfort ‘satisfier’ condition is also met. The use of the place during the day is an important aspect to the comfort of public space. And the maintenance plays a significant role for amenities like bicycle parkings. Also the traffic is expected to be comfortable by giving the cyclists right of way as much as possible (Bach, 2006; Borgman, 2003; ECF, 2006; Forsyth & Krizek, 2011).
Fig. 6.12 Conditions for successful public space for cyclists
The last condition of the four, attractiveness, plays a significant role in the overall liveliness of public space. This has to do with the scale of the buildings and the options to take an alternative route. But also the detailed urban design can make a place even better than it already is. Making a place more attractive greatly influences the image of the city. Therefore, this condition is a task on itself. This last condition can only be fulfilled if all the other conditions are met (Bach, 2006; Borgman, 2003; Forsyth & Krizek, 2011; Gehl, 2006).

The review of a variety of literature shows us that we can use and transform the conceptual framework of Gehl to meet the quality of public space for cyclists. First the condition directness can be added to the model, above the fundamental element of protection. Second, the protection element is by many authors considered as the ‘safety’ of public space. This condition is used in terms of traffic, social and personal safety. The same counts for the delight condition. By many authors this is considered as attractiveness. Therefore, we can change the naming of protection into safety and delight into attractiveness.

The main objective of this paper is to develop a list of conditions for successful public space for cyclists. Summarising, the conceptual model for pedestrian landscape of Gehl (from the field of Urbanism) and the pyramid of van Hagen (from the field of Consumer psychology) together with the outcome of the literature study creates a pyramid model adjusted for the quality of public space for cyclists (figure 7.1). The fundamental elements of the Maslow pyramid can be recognised in the development of this new pyramid. The pyramid is used as benchmark for case study research in the graduation project.

7.0 Conclusions

This paper investigated the question: What are the conditions for successful public space for cyclists to strengthen the bikeability from home to the Dutch railway station? Based on [i] the theory of Gehl (from the field of Urbanism) [ii] the theory of van Hagen (field of Consumer psychology) and [iii] a variety of spatial planning and design oriented literature, a new pyramid has been developed: the pyramid for successful public space for cyclists as shown in figures 7.1.

The most fundamental element, safety, is placed at the bottom of the pyramid. If this condition is not met, the other conditions cannot be fulfilled. Together with the second element, directness, it forms the group of dissatisfiers. The third and fourth condition, comfort and attractiveness, are the satisfiers. Cyclists value a place even higher if also these two conditions are met on top of safety and directness.

The result of this paper sets the base for a benchmark for successful urban environment for cyclists. The outcome has been used as evaluation tool in the graduation project ‘ReCYCLE City’ to test the current quality of the bicycle network from home to the railway station by case study research (Scheltema, 2012). Finally, a design proposal was made for one of the cities to improve the bicycle network from home to the railway station.
Fig. 7.1 The pyramid (left) and conditions for successful public space for cyclists (right)

1. Safety
   a. Road division
   b. Visibility & lighting
   c. Pavement

2. Directness
   a. Linearity
   b. Continuity
   c. Right of way to bicyclists
   d. Orientation
   e. Fluency
   f. Flatness
   g. Legibility
   h. Transfer distance
   i. Bicycle parking capacity

----------------------------------------------------

3. Comfort
   a. Human scale
   b. Special bicycle amenities
   c. Bicycle parking types
   d. Bicycle racks
   e. Bicycle parking levels

4. Attractiveness
   a. Maintenance
   b. Liveliness
   c. Experience
This part of the thesis answers the main research question of the graduation project, namely: *What spatial design interventions can create a strong, consistent and attractive bicycle network to strengthen the bikeability from home to the Dutch railway station?*

To answer this question four sub research questions are formulated. These sub research questions have been answered in part B, C and D of this thesis. The literature study, case study research, workshop and the design form the base to answer the main research question. This chapter will be finished with reflections on the graduation project and recommendations for the future.
8. SUMMARY AND CONCLUSIONS

At the start of this graduation project it was obvious that the bicycle routes from home to the railway station are weak and there is a lot of room for improvement. The significance of this issue is acknowledged by NS Stations. By offering the author the opportunity to study on this subject, the first step is made to successful public space for cyclists from home to the railway station.

The main research question of the graduation project is: What spatial design interventions can create a strong, consistent and attractive bicycle network to strengthen the bikeability from home to the Dutch railway station? This questions is answered by formulating four sub research questions. Each of them is discussed in a separate part of the thesis and focuses on clear end products (see figure 8.3).

The result of sub research question 01 is a list of subconditions for successful public space for cyclists to strengthen the bicycle route from home to the Dutch railway station (see figure 7.2). These results of the literature study were used to test the bicycle routes in various Dutch practices during the case study research. The outcome of the first sub research question was used to develop a manual for the validation tool and give answer to sub research question 02. This is used for the development of a hierarchy in the list of conditions for successful public space for cyclists (figure 7.1), the answer to sub research question 03. The overview of conditions is integrated in a validation tool, the ReCYCLE City tool. On the basis of this tool a series of eleven bicycle routes was objectively validated and compared. The results of the case study research gave an overview of the strong points and opportunities of the bicycle route. Another important aspect of the tool is that is pinpointed what actions should be undertaken to improve the bicycle route to the station. The ReCYCLE City tool can not only be used as a validation tool, but also as a design tool.

At the start of this graduation project it was obvious that the bicycle routes from home to the railway station are weak and there is a lot of room for improvement. The significance of this issue is acknowledged by NS Stations. By offering the author the opportunity to study on this subject, the first step is made to successful public space for cyclists from home to the railway station.

Sub research question 04 opened up the understanding to look at the city in a larger perspective. From the set of case study bicycle route, one of them was selected to work out in a design
Main Research Question.

What spatial design interventions can create a strong, consistent and attractive bicycle network to strengthen the bikeability from home to the Dutch railway station?

Sub RQ #01.
Refining successful public space for cyclists.
What are the conditions for successful public space for cyclists to strengthen the bikeability from home to the Dutch railway station?
Result: Paper ⇒ Conditions
Method: Literature Review

Sub RQ #02.
Applying the conditions for successful public space for cyclists:
How are the conditions for successful public space for cyclists applicable to test the quality of the bicycle network from home to the Dutch railway station?
Result: Manual ⇒ evaluation tool
Method: Design an evaluation tool based on results of literature review and tested in case study research in Sub RQ #03.

Sub RQ #03.
Analysing the current bicycle network:
What is the current quality of the bicycle route between the Dutch home and the railway station in comparable case studies in the Netherlands?
Result: Atlas ⇒ case study analyses
Method: Case study research based on the evaluation tool of Sub RQ #02.

Sub RQ #04.
Selecting city for Sub RQ #04

Preliminary Thesis Plan
P1
P2
P3
P4
P5
P6

Preliminary Thesis
Thesis
Graduation

Fig. 8.1 Methodology approach

Spatial design interventions fixing the bicycle network between home and the railway station
The city of choice had a low outcome from the tool. And above all, had a lot of potential to improve (see figure 8.4-7). The outcomes of the case study research formed a good base for the start of the design.

The problem analysis brought to light that the lack of activity in the station area is visible in the activity network of the city. More activities should be added and they should be better integrated in the urban fabric.

To answer the main research question of the graduation project the result of all sub research questions can be formulated in three steps:

**Step 01:** First, the bicycle route from home to the railway station should be validated with the ReCYCLE City tool. The outcome pinpoints the strong points and opportunities of the bicycle route and recommendations to improve the bicycle route from home to the railway station.

**Step 02:** The second step is to analyse the city in a larger perspective. This can give insight in creating shortcuts that work even better. Putting the bicycle route in large perspective also helps to get an overview of the activity network in the city in order to integrate the functions as part of the city.

**Step 03:** Finally, use the conditions for successful public space for cyclists to make spatial design proposals, namely: safety, directness, comfort and attractiveness (see figure 8.2).
1. Safety
   a. Road division
   b. Visibility & lighting
   c. Pavement

2. Directness
   a. Linearity
   b. Continuity
   c. Right of way to bicyclists
   d. Orientation
   e. Fluency
   f. Flatness
   g. Legibility
   h. Transfer distance
   i. Bicycle parking capacity

3. Comfort
   a. Human scale
   b. Special bicycle amenities
   c. Bicycle parking types
   d. Bicycle racks
   e. Bicycle parking levels

4. Attractiveness
   a. Maintenance
   b. Liveliness
   c. Experience
Fig. 8.3 Results of the case study research
Fig. 8.4 Recommendation to improve the bicycle routes to station Amsterdam Amstel

Fig. 8.5 Variant 2015.

Fig. 8.6 Variant 2020.

Fig. 8.7 Variant 2030.
JULIANAPLEIN - FUTURE IMPRESSION
WEESPERZIJDE - FUTURE IMPRESSION
PART F - CONCLUSIONS - IMPROVING THE BICYCLE NETWORK
9. RECOMMENDATIONS

This thesis had brought three main products to the researchers and designers:

1. A suitable and easy-to-use validation tool;
2. A theoretical approach to study the bicycle routes and improve them in the urban spatial context.
3. An example of how the theoretical approach can be used for a spatial design to improve the bicycle route from home to the railway station.

From the beginning of this graduation project, the author noticed that studying the bicycle route from home to the railway station is in an infant stage. The research done in this thesis can be seen as the first steps towards more bicycle research in the urbanism field. The recommendations in this chapter describe how future research can contribute to the three end products of this graduation project.

In the first place, further research would be recommended to get grip on the costs and benefits of the interventions that are needed to meet the conditions of the validation tool. This research could show what interventions have the most positive impact for the project area in relation to the size of the investment.

The validation tool provides already recommendations to design a clear and inviting entrance of the bicycle parking and the station. Though, practice shows that bicyclists often do whatever they want with their bicycle in public space. This forces municipalities to undertake strict bicycle removing policies. As extension of this research, it could be recommended to research the relationship between the urban design and the bicycle movement in public space. This could lead to new design recommendations to develop

It could also be recommended to research the costs and benefits of a bicycle parking in relation to park and ride facilities. This investigation could give insight in the opportunities to develop bicycle parking facilities with balanced books.

Another recommendation would be to investigate the opportunities of combining the bicycle parking facilities with other functions (e.g. park and ride and/or retail) in a working business model. In the first place to improve the experience of cyclists and the customers in general. And second, to offer good bicycle facilities at every station in the Netherlands. This research could be an interesting opportunity for NS Stations since on average 43% of the train travelers uses the bicycle to reach the station. This research could be used to further improve the customers experience and tackle the bicycle parking investments that have to be made at every station.

As extension of this project, more research could be done on the effectiveness of the bicycle in relation to other transportation modes. A comparison on the investment and benefits per transportation mode will clarify what the most effective transportation mode is to invest in. Not only the direct costs (i.e. building infrastructure), but also the indirect costs, such as spatial occupation, should be taken into account. And the benefits do not only exist of direct tax revenues, but also indirect benefits like public health, spatial quality and (small) economic activity has to be considered. By doing this the
return on investment will become clear and governments can convincingly invest in the most effective transportation mode.

Last but not least, more research could be done on the social and economical benefits of bicyclists in a city. For example, interesting research could be done on the effect of bicyclists on the liveliness of the urban environment and the economical activity in a project area. The outcome of this research could indicate the economical value of a bicyclist in a project area. If the added economical value of bicyclists for a street or square can be defined, parties will be triggered to invest in good cycling facilities to serve the bicyclists’ needs. Since NS Stations has a major interest in the station area to optimal serve its customers, it would be a logical step for NS Stations to take the lead in this investigation.
10. REFLECTION

This chapter reflects on the methodology of the graduation project and the content of the thesis.

10.1 Reflecting the methodology
At the start of this graduation project it became clear that this subject had not been part of research before. Although, there was a lot of bicycle literature, it was often focussed on only the safety and well-being of the bicyclists. Less research has been done on the experience of the environment by cyclists. The development of the validation tool was therefore not that easy. In collaboration with NS Stations and the mentor team at TU Delft a validation tool was elaborated. This resulted in a set of conditions that was frequently updated through the year.

The developed tool proves to be a excellent method to validate bicycle routes and make improvements. The step that was made from a list of conditions to a hierarchic tool was a tough assignment. With the ReCYCLE City tool, a first step is made to objectively measure the quality of the bicycle routes.

Later on the case studies and the workshop helped a lot in improving the validation tool in practice. This brought the validation tool again a step further. When the validation tool was used to make spatial design interventions, it became clear that the city should be viewed from a larger perspective as start for the design proposals. The design has been developed in cooperation with interviews with Inoek Brouwer, Susan de Vos, Willem van Heijningen (Asset Development, NS Stations) and GeertJan Cronenberg (City of Amsterdam).

10.2 Research by Design or Design by Research?
The methodology part of the thesis shows how this graduation project has used both ‘Research by Design’ and ‘Design by Research’. Two products were derived by research and two by design. The first product, the paper with a list of conditions, was a result of the literature study. The second product, the validation tool, is the outcome of the literature study and a case study research. The third product is an atlas with the case study research. The fourth products are spatial design interventions to improve the bicycle route in Amsterdam Amstel.

Both methods have contributed to the same level in this graduation project.

10.3 Reflecting the content
The current political climate stresses the search for the most effective transportation mode. Taking all costs and benefits into account, the bicycle is the most effective way of transportation within and even outside the Dutch cities. In combination with public transport all opportunities are open. The challenge for the future will be to optimize the combination of cycling with public transportation.
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Images lacking referencing are made by the author.
Appendix A - Interviews

Besides all valuable meetings with my mentors and colleagues at NS Stations the past year, I also had many inspiring talks and interviews with experts in the field. Below an overview of the people who inspired me during the conversation we had on the subject of my thesis.

Henco Bekkering  
Professor in Urban Design  
Department of Urbanism, Faculty of Architecture, TU Delft

Otto van Boggelen  
Expert on traffic and transport  
Fietsberaad

Wim Bot  
Cycling expert and (international) policy advisor  
Dutch Cyclists’ Union (‘Fietsersbond’)

GeertJan Cronenberg  
Urbanist  
City of Amsterdam

Kees van Goeverden  
Expert on transport and travel behaviour  
Faculty of Civil Engineering, TU Delft

Eva Heinen  
Assistant professor Planning and Mobility  
University of Groningen

Jos van der Hende  
Architect & Urbanist  
Bureau Spoorbouwmeester

Boris Hocks  
Urban designer and partner of POSAD  
POSAD Spatial Strategies

Jan Honning  
Urbanist  
StedenbaanPlus

Maurits de Hoog  
Chairman of Urbanism Department  
Faculty of Architecture, TU Delft

Henk Ovink  
Director of National Spatial Planning, the Netherlands  
Dutch Ministry of Infrastructure & Environment

Lee Verhoef  
Expert on station areas and cycling  
ProRail

Marek Vogt  
Architect & Urbanist  
We Love the City

John Westrik  
Associate professor in Urban Compositions  
Department of Urbanism, Faculty of Architecture, TU Delft
In Dutch culture, cycling and walking are the most common ways of active transportation within the city. Nowadays, more than forty percent of all train passengers arrive at the railway station by bicycle. And it is estimated that the combination of bicycle and train will become even more important in the future. But the spatial quality of the bicycle network from the Dutch residential neighbourhoods to the railway station is often poor: uncomfortable and incoherent. Urban design might and should bring solutions. Unfortunately, the cyclist’s perspective is worldwide under-represented in even the most comprehensive work of urban design.

This Master’s thesis is a search for spatial design interventions to improve the bikeability from home to the Dutch railway station.