

Designing for a future urban mobility system

Targeting inclusivity as a commonality in three Rotterdam neighbourhoods

Colophon

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Delft University of Technology
Louwman Group

Author

Arabella van Lookeren Campagne

Supervisory team

E. van Grondelle (Delft University of Technology)
Dr. Ir. S. Hiemstra-van Mastrigt (Delft University of Technology)
Ir. P. van den Boer (Louwman Group)

Preface

In front of you lies the graduation report: 'Designing for a future urban mobility system: targeting inclusivity as a commonality in three Rotterdam neighbourhoods'. This report serves as the final deliverable for my MSc Integrated Product Design (IPD) programme at the Delft University of Technology.

Over the past few months, I have been exploring the complexities of mapping mobility needs and wants in different Rotterdam neighbourhoods. How can we better respond to personal preferences within an urban mobility system in a way that is both feasible and manageable?

We observe that urban mobility is undergoing significant change. Cities are expanding and at the same time there is a desire to maintain its sustainability and quality of life. We are increasingly encountering forms of mobility that lie somewhere on the spectrum between car and bicycle, introducing a realm of micromobility. But what is really relevant to Rotterdam's commuters and fits in with their diverse lifestyles?

This report is not intended to provide you a definitive answer to such a complex challenge of urban mobility. Instead, it serves as a source of inspiration to initiate discussions around this issue. What is possible, and what are potential approaches? With the insights and ideas presented in this project, I aim to inspire further exploration.

Arabella van Lookeren Campagne

June, 2024

Executive Summary

The urban mobility transition is in full swing. Growing urban populations, increasing traffic congestion and the need for more sustainable transport solutions are forcing cities to think about the future of mobility. This transition is also strongly present within Louwman Group, where the focus has traditionally been on cars, but where mobility is being interpreted more and more broadly. However, to stay ahead in this mobility transition, a forward-looking strategy is essential. In order to explore what mobility will be relevant in the future, it is crucial to gain more insight into mapping mobility needs and wants in urban areas. This report explores, in the context of three Rotterdam neighbourhoods, how differences and commonalities can form the base for a mobility solution that offers people a more personalised mobility experience in a feasible way.

The research revealed that in each neighbourhood, vulnerable groups are excluded from the mobility system in different ways. Through a product-service combination, the issues experienced by these vulnerable groups are explicitly addressed, while at the same time relevance for a wider audience is targeted (Figure 1). This way, the concept reflects the balance between personalisation and generalisation. This was achieved in four phases:

Phase I: Dijkzigt/Nieuwe Werk, Feijenoord and M4H

Through quantitative desk research, all Rotterdam neighbourhoods within the ring were compared at city level to find three neighbourhoods with contrasting characteristics. This was done to explore how mobility related values can differ within the same city. This analysis resulted in the selection of Dijkzigt/Nieuwe Werk (Centre), Feijenoord (Feijenoord) and M4H (Delfshaven). These neighbourhoods differ in terms of demographic characteristics, types of travellers, mobility use, mobility quality and planned level of development (from page 24).

Phase II: Out into the neighbourhood

The desk research in Phase I provided a basic understanding of the characteristics of the three neighbourhoods, but still raised many questions. By going into the neighbourhoods, more in-depth qualitative research was carried out through observations, surveys and interviews to uncover what lay behind the figures from Phase I (from page 36).

Phase III: Common ground and unique traits

In Phase III, the wealth of gathered information was analysed to explore what makes each neighbourhood different and what they have in common. By plotting the three neighbourhoods on different axes, it became clear how they relate to each other. It emerged that vulnerable groups in each of the three neighbourhoods are excluded from the mobility system in different ways (from page 54).

Phase IV: Designing for inclusivity

This commonality became the focus and starting point for the ideation phase. The intended concept had to address an increased sense of safety in busy traffic (Dijkzigt/Nieuwe Werk), a sense of mobility freedom (Feijenoord) and the integration of vulnerable groups into an innovative mobility system (M4H), while also being relevant to a wider non-vulnerable audience. Vulnerability is interpreted as a spectrum and covers a variety of forms and degrees (from page 78).

This resulted in a product/service combination centred on a modular and stable bicycle as an addition to the shared mobility offer in Rotterdam. A stable bicycle (with three or four wheels) caters to older people, people with physical limitations or people who have not (yet) mastered the skills of cycling. These people are often restricted in their freedom and the current system does not adequately meet their

needs and wants. The bike offers the opportunity for two people to cycle together, addressing social aspects, accessibility and providing a low-threshold way for people to try cycling. Through a matching process and credit system, people are encouraged to help and support each other in experiencing mobility freedom, safety and integration. In addition, the bike can be used for free or at a reduced rate by eligible people if it is not reserved. Instead of a second seat, modular add-ons can transform the bike for a variety of purposes, such as cargo, child seats and a roof (from page 86). This makes it relevant and interesting for a wide audience to use.

The concept is in line with the values and essence of Louwman Group: Mobility for life. It should be possible and accessible for everyone to move freely. While mobility often focuses on the extremes of the vulnerability spectrum - either non-inclusive mobility for non-vulnerable people, or special needs transport for vulnerable groups - there is little for those in between (from page 112).

Both the concept and the approach to mapping needs/wants and differences/similarities can be applied in other areas and at other scales. This scalability and applicability makes it interesting for Louwman Group. The approach used can help Louwman Group link mobility features and concepts with future needs and wants, leading to better substantiated investment decisions. In addition, by working backwards in the approach, the current portfolio can be examined to identify for whom, where and why Louwman Group's current solutions are of interest. This helps Louwman Group work towards a complete and user group driven portfolio (from page 126).

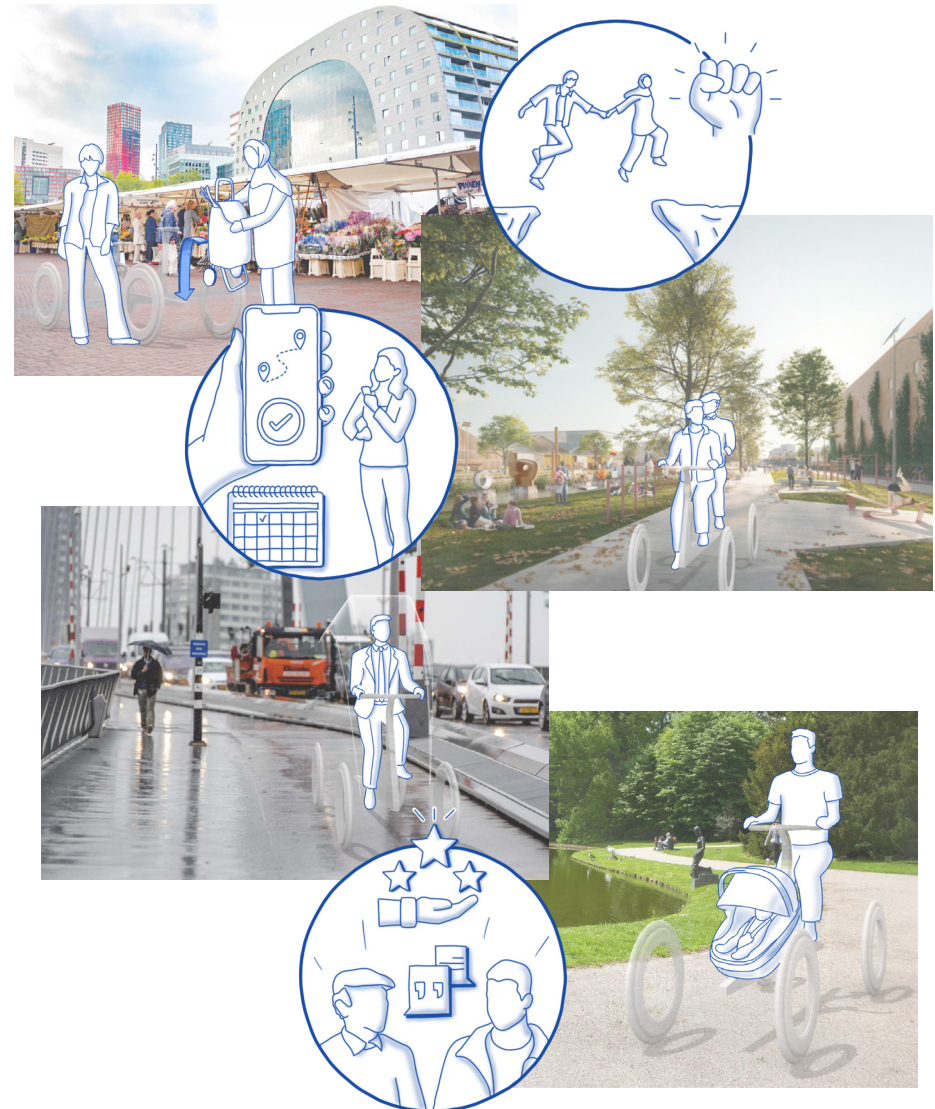


Figure 1: Envisioned concept experience

List of definitions

Modality

The way someone travels, also known as the mode of transport (e.g., bicycle, walking, car, bus, shared scooter).

Micromobility

Micromobility is an urban transport solution aimed at providing a solution for short-distance travel. The appeal of micromobility is that it provides flexible, sustainable, cost-effective and on-demand transport alternatives (Shaheen et al., 2020).

Shared mobility

Shared mobility refers to the shared use of mobility (e.g., shared cars, bicycles, scooters). The focus here is on usage rather than ownership.

Mobility hub

Physical links between modes of transport that, in addition to their mobility function, can also serve as focal points for spatial development. The linkage function of the mobility hub is focused on facilitating multimodality, which refers to the combination of different modes of transport for the journey from A to B (Witte et al., 2021).

Needs

Fundamental base for someone's functioning. They are roughly the same for everyone, remain constant over time and in different situations.

Wants

Addition to the more fundamental needs. They optimise the experience and therefore play a less vital role than needs. Wants can be personal, influenced by time and situational factors.

Huizen van de Wijk

In every neighbourhood in Rotterdam there is a 'Huis van de Wijk', a network established by Gemeente Rotterdam. A 'Huis van de Wijk' is a meeting place for local residents, similar to a community centre.

Mobility as a Service (MaaS)

Mobility as a Service (MaaS) integrates various forms of transport and transport-related services into a single, comprehensive, and on-demand mobility service. MaaS offers end-users the added value of accessing mobility through a single application and a single payment channel, instead of multiple ticketing and payment operations (MaaS Alliance, n.d.).

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Introduction

1.1 Introduction

Rotterdam stands out among Dutch cities for its strong emphasis on automobiles. After the 1940 bombing, the city was rebuilt along the lines of American cities where cars were central, and where living, working and recreation were separated (OPEN Rotterdam, 2016).

Growing urban populations, increasing traffic congestion, and the need to use more sustainable transport solutions are forcing cities to think about the future of mobility. This centres on seamless, efficient and environmentally friendly transport systems that improve the traveller's user experience.

Rotterdam is currently undergoing a mobility transition in which the car is playing an increasingly less prominent role. More space will be given to pedestrians, cyclists, public transport or other sustainable means of transportation (Gemeente Rotterdam, 2021).

This transition is also strongly noticeable at Louwman Group, which started 100 years ago as a Dutch importer of American automobiles. Nowadays, Louwman Group is transforming into an organisation where the definition of mobility extends beyond the automobile, following the pledge: 'Mobility for Life'. Within this transformation falls the interest in exploring the future of urban mobility.



Figure 2: The 's-Gravendijkwal is an important north-south connection on the west side of Rotterdam city centre (OVMagazine, n.d.).

1.2 Project assignment

A strategic approach for future-forward mobility

Louwman Group has its roots in the automotive industry. Over the years, however, the company has broadened its interpretation of mobility and increasingly invested in other modalities. Louwman Group recognises that, particularly in urban areas, there is a growing number of intermediate forms of mobility between the car and the bicycle, known as micromobility. This emerging market is one that Louwman Group wants to better understand and control. In line with the brand essence ‘Mobility for Life’, Louwman Group strives to provide the right mobility solutions for everyone at every stage of their lives. However, what these future solutions will look like, remains a question that Louwman Groups wants to explore further.

Currently, Louwman Group’s approach is primarily to invest in current business models, which tends to be more short-term. Given the rapid pace of change in the world and the transition in the mobility sector, Louwman Group wants to explore investing in more future-oriented business models. This forward-looking strategy is somewhat new for Louwman Group, and to manage this approach, this project aims to conduct research to better understand mobility needs and wants. This can subsequently form the base to offer more personalised and suiting mobility solutions, which allows Louwman Group to stay ahead in the mobility transition. This research aims to help Louwman Group argue why certain forms of micromobility are a relevant addition to their portfolio and why others are not.

Purpose for Louwman Group

At Louwman Group, the concept of ‘Mobility for Life’ revolves around understanding and giving meaning to mobility in different life stages, situations and environments. Whether it is urban or rural, for young or old, Louwman Group is committed to exploring the role of mobility in different aspects of life, aiming to develop inclusive and effective mobility solutions for different communities. While Louwman Group does not have a specific focus on cities, urban areas often present a diverse mix of

people, cultures and habits, making them an intriguing landscape to explore in this project. In addition, as cities increasingly envision a car-free future, they provide an appropriate context to explore all aspects of mobility except the car - something of interest to a company with a century-long specialisation in automobiles. Additionally, Louwman Group is interested in exploring micro mobility in the context of urban mobility hubs. Therefore, mobility hubs will have a facilitating role in the context of this project.

For Louwman Group, the value in this project lies primarily in the approach: how to address personalised mobility in a scalable and feasible way? Therefore, any concept derived from the research results is more of an illustration of what could be a potential outcome of such an approach. Louwman Group is a national organisation where scalability is a key factor. Overly personalised mobility isn’t feasible, and applicability to other contexts is also important. Scalability remains a constant consideration throughout the project.

Context Rotterdam

The context of the city of Rotterdam is well suited for an analysis of mobility needs and wants due to its remarkable diversity in neighbourhoods, population composition, culture, urban layout, infrastructure, activities, and types of travellers. This diversity leads to interesting contrasts within the same city. Therefore, analysing different areas in Rotterdam gives Louwman Group an insight into how it can offer a more comprehensive portfolio targeting a greater diversity of needs and wants.

However, by focusing on a great diversity in mobility needs and wants, a multitude of mobility solutions will follow, which makes the system complex and unfeasible. Which elements overlap and have potential to form a common base in an urban mobility system?

1.3 Project stakeholders

Several parties are involved in this project (Figure 3). The project is carried out by the TU Delft Faculty of Industrial Design Engineering in collaboration with the client Louwman Group. The direct relevance of the project is therefore also for Louwman Group. However, other parties are closely involved. As the project is applied in the context of Rotterdam, Gemeente Rotterdam (the Municipality of Rotterdam) is an important stakeholder in the project. Gemeente Rotterdam sets a regulatory framework around public mobility that a party like Louwman Group has to take into account. They are therefore heavily involved in the implementation and operational aspects of mobility initiatives in the city. Finally, the residents and other travellers of the city are obviously relevant in this project as they are the intended end users. They will colour the canvas of the project with their needs and wants.



Figure 3: Stakeholder overview

1.4 Project approach

The project approach can roughly be divided into four phases: 'Select three contrasting areas', 'In-depth area research', 'Identify differences and similarities', and 'Design a concept'. Throughout the phases there is an alternating process of divergence and convergence. The approach is based on a double diamond model (Design Council, 2005), but adds its own twist tailored to the project (Figure 4). Roughly, the first diamond focuses on context, the second on interaction, and the third on product.

Phase I: Selecting three contrasting areas

In the first phase, the context is established. By first quantitatively analysing Rotterdam as a whole, a choice can then be made for the three areas that will serve as the case in this project. Existing theories on modality choice are used to determine which areas are likely to be most diverse.

Phase II: In-depth area research

In the second phase, each area will be studied qualitatively, allowing for more richness and depth. This involves emerging questions, gathering data from participants in their own environment (Creswell, 2007). The gaps and questions left after the first phase will be filled in here - what lies behind the facts and figures on city-level? The information gathered will be used to map the needs and wants in each area.

Phase III: Identifying differences and commonalities

In the third phase, convergence takes place within all the data collected. What is relevant and what adds value to this research? The data is analysed to find common themes, and is interpreted in a way to uncover its deeper meaning (Creswell, 2007). The goal is to identify differences and similarities, as these will form the basis of the design phase.

Phase IV: Designing a concept

In the final phase, a concept is developed based on a commonality that addresses the specific wants of the neighbourhoods as well. This involves striking a balance between personalisation and generalisation.

Reading guide

The structure of the report follows the 4 phases and is divided into chapters based on that. In addition to the 4 phases, contextual research was also carried out. These are background insights collected in parallel with the main process, and are not directly linked to a specific phase. They form the starting point of the report.

Each chapter ends with a conclusion and evaluation, which summarises and highlights the key findings of the phase. For Louwman Group, the approach is an important part of the project. Therefore, approach related recommendations, limitations and reflections on scalability are discussed. The report ends with a general conclusion, discussion, limitations and recommendations, where the project as a whole is discussed.

1 Selecting three contrasting areas

Roughly analyse Rotterdam as a whole to pinpoint interesting contrasting areas (quantitative analysis).

 City level

2 In-depth area research

In-depth research by collecting data for each area (qualitative data collection). What lies behind the numbers?

 Area level

3 Identifying differences and commonalities

Identify differences based on area specific wants en similarities based on common needs.

 City level

4 Designing a concept

Design a concept based on similarity between the areas that targets area specific wants at the same time.

 City/Area level

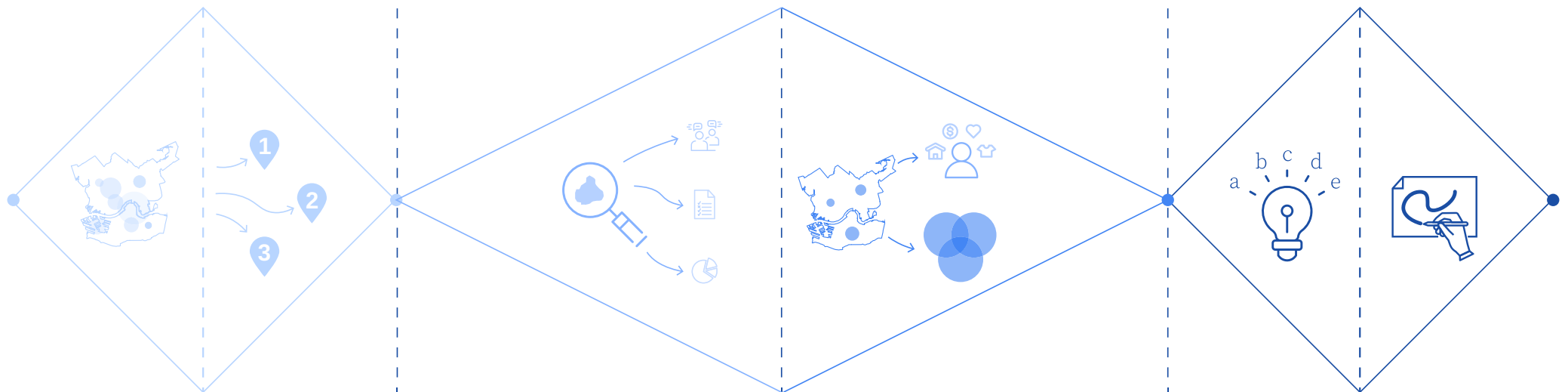


Figure 4: Overview of the total project approach.

Contextual research

2.1 Introduction

As explained in the approach, the project consists of roughly four phases. These phases serve as steps for conducting the research. However, alongside these phases, some general insights and relevant background information have emerged throughout the project. This process unfolded in parallel with the execution of the four phases.

These insights have been gathered through a combination of desk research, interviews with Gemeente Rotterdam, and the ongoing process of refining the direction of the project. This chapter delves into these insights. The themes discussed provide a basis for interpreting the rest of the research.



Figure 5: Stationsplein Rotterdam (Bos, 2016)

2.2 Rotterdam: the most car-friendly city in the Netherlands

Radically Reconstructing the city

After the bombing on May 14, 1940, Rotterdam undertook a radical approach to reconstruction. Rotterdam is renowned for adopting a novel approach with innovative ideologies about a functional city compared to other affected Dutch cities. A blank canvas had emerged to apply these ideas in which the car is central.

Traffic flow has been a crucial point of focus. In later years, even more demolition took place to further enhance traffic flow in the city. Scarce old buildings were ruthlessly demolished if they hindered the way (Wederafbraak, n.d.).

The plans for reconstruction generated a lot of enthusiasm, but towards the end of the 1960s, criticism began to emerge. People found it too grim, bare, and businesslike, longing for a more social character with more greenery and a stronger people focus. Amsterdam-based architect Piet Blom was asked to bring back some vibrancy with contemporary architecture (Wat Is Wederopbouw, n.d.). However, the emphasis on the car persisted and, along with the perceived benefits, remained an important part of the urban design. This only began to change when there was a broader awareness of the disadvantages of car-centric mobility.

Challenges and perspectives in shaping Rotterdam's mobility future

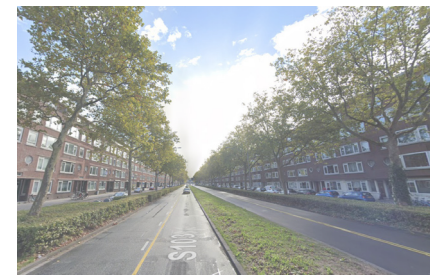
Wide city boulevards, such as the 's Gravendijkwal, Pleinweg, and Stadhoudersweg, are placed in a way to make the traffic flow across the city as smooth as possible. Squares, such as Hofplein, Marconiplein, and Droogleever Fortuynplein, serve as major traffic junctions, as illustrated in Figure 6 (Van Eijck, 2020). Such an infrastructure creates the ideal environment for car drivers.



's Gravendijkwal



Hofplein



Pleinweg



Marconiplein



Stadhoudersweg



Droogleever Fortuynplein

Figure 6: Examples of wide city boulevards (left) and squares (right) in Rotterdam (Google Streetview, 2023)



“It will be beautiful, Rotterdam will be a beautiful city.” Rotterdam will be spacious, it will have the allure of a metropolis: the fast-moving traffic, the wide boulevards, and the tall buildings will collectively create an atmosphere of bustle in keeping with contemporary life. It will not be cosy, but at the moment we would rather see a row of shiny cars than a carriage with old ladies, and feel more at home in a shop made of glass and mirrors, than in a stuffy grocery shop, where the smell of cloves, soap and candy tickles us pleasantly. Rotterdam will be our city, the city of twentieth-century man.”

- Rein Blijstra

Rein Blijstra was a literary and urbanist. Translated from Het Vrije Volk 13-11-1952, a Dutch social democratic newspaper (Wat Is Wederopbouw, z.d.).

Figure 7: Hofplein in 1967, a symbol of Rotterdam's new infrastructure (Vocke, 2018)

The vicious circle of car dependence shows the relation between the amount of cars, car use, car infrastructure, and car dependency (Figure 8). An increase of one element in the circle results in that the other elements will also increase. With the expansion of the car system and infrastructure in Rotterdam during the reconstruction period, non-car-users will be constrained, resulting in a general increase in car dependence (Ministerie van Infrastructuur en Waterstaat, 2023).

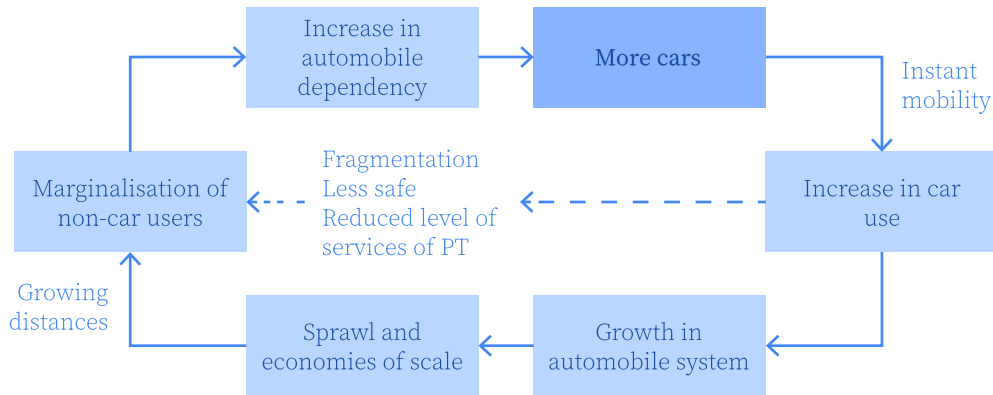


Figure 8: Vicious circle of car dependence based on Plane (1995) (Zijlstra et al., 2023)

However, the city wants to move towards a cleaner, greener, and safer Rotterdam with less room for cars and more for cyclists and pedestrians as shown in Figure 9 (Gemeente Rotterdam, 2021). But making a city like Rotterdam, with its wide boulevards and central traffic junctions more car-free, is a complex task. The city structure developed during the reconstruction disadvantages this process. Organically built cities can more easily be made incrementally car-free by doing so ring by ring. But in a city like Rotterdam, you have to approach this differently. The municipality takes small steps since there are many dissenting voices. Politicians and entrepreneurs fear Rotterdam's reputation as an easily accessible city. Figure 10 shows how the Weenatunnel creates a bit more space for other forms of mobility around the central station. At the same time, people still feel that the city centre is accessible by car. Additionally, the plans are often perceived as an attempt to impose an elitist lifestyle on low-income individuals by pushing them out of their cars (Van Eijck, 2020).

During this project, several people from the shared mobility team within Gemeente Rotterdam were interviewed. It was highlighted that the degree of innovation is a constant reflection of whether the board is left- or right-oriented:

“Councilor Judith Bokhove (GroenLinks) was involved in drawing up the ‘Rotterdamse mobiliteitsaanpak’. Now we have Vincent Karremans (VVD), you can observe a significant difference there. This is also noticeable in the mobility department; we want to fully accelerate the mobility transition since the city needs to change. However, there are obstacles from all sides. It’s frustrating because it could be different.”

- Interviewee ‘team shared mobility’ at Gemeente Rotterdam

“In the current city, the car still holds a dominant position. Parking generates €200 million per year, which highlights the complexity of implementing other initiatives. What are the potential benefits of such changes? These are all complex questions.”

- Interviewee ‘team shared mobility’ at Gemeente Rotterdam

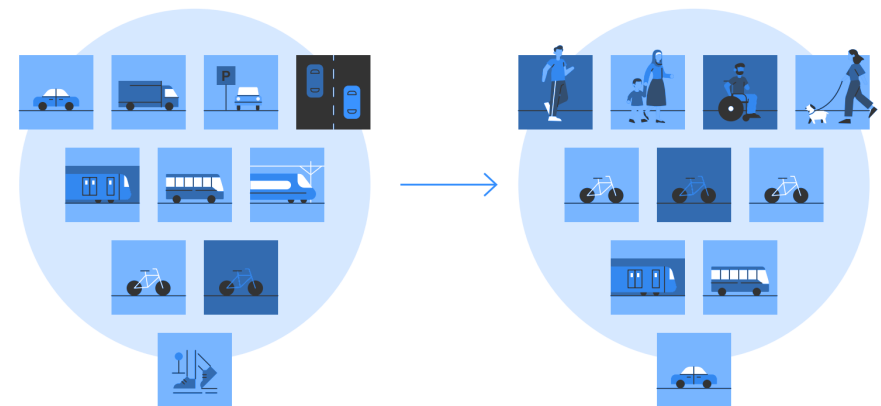


Figure 9: Mobility pyramid. Objective to change the ratio of space for each type of transport (Gemeente Rotterdam, 2021). With the STOMP (stappen, trappen, openbaar vervoer, MaaS, privéauto; ENG: walking, cycling, public transport, MaaS, private car) prioritisation principle, more sustainable forms of mobility are given priority and less sustainable forms are given lower priority (CROW, n.d.).

Rotterdam as the context for this study

It is an extra interesting challenge to focus on Rotterdam within this project, compared to other cities in the Netherlands. In terms of liveability, Rotterdam is, on the one hand, a pleasant city for car users to live and travel in. Due to the city's well-suited infrastructure for automobiles, it is more attractive for travellers to use cars. On the other hand, liveability is also influenced by factors such as air quality, noise pollution, and traffic safety, where cars have a negative impact. In addition, cars create significant spatial intakes, which could also be used in a way that could improve livability in a different and more significant way. It is intriguing to explore how the city can become livable for everyone in a way that is future-proof at the same time. How can the city remain easily accessible, and meet travellers' needs and wants while simultaneously working towards a more sustainable city?

In addition, Rotterdam lends itself well to this research because of the great diversity within the city; a diversity in neighbourhoods, cultures, nationalities, religions, values, opinions and political preferences. With more than 170 nationalities, no group is strongly in the majority (Gemeente Rotterdam, 2021). With a diversity of people, together with a diversity in area-related factors, comes a diversity of mobility preferences and interesting contrasts. This also makes it valuable for Louwman Group to focus on, since the interest is to provide mobility for a wide range of people and cases.



Figure 10: At Rotterdam central station, cars go underground to create more space for other traffic (OVMagazine, n.d.)

2.3 Personalisation vs generalisation

The theme 'personalisation vs generalisation' refers to the balance between personalised mobility and generalised mobility, which can be seen as a scale. This scale, and the relationship between these two extremes, form a common thread in this study.

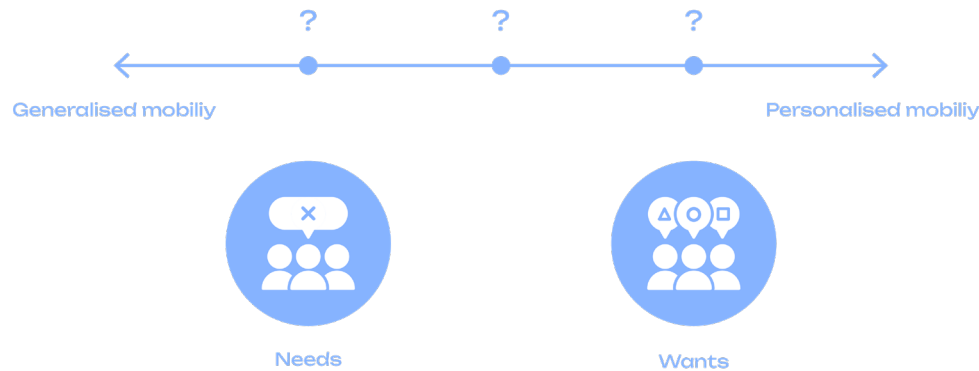


Figure 11: Scale of personalised mobility (want focus) and generalised mobility (need focus).

Needs and wants

There are different theories about how to distinguish needs and wants. McGregor et al. (2009) suggest that one way is to consider whether the absence of something would result in harm. (Doyal & Gough, 1984) suggest that needs are objective and universal, central to human well-being or suffering. In any other case, it can be considered a want.

Based on Maslow's hierarchy (1954) in Figure 12, the values of an average traveller can be organised in order of importance into a pyramid, see Figure 13 (Van Hagen, Peek & Kieft, 2000). The base consists of basic needs such as reliability and safety, followed by speed, ease, comfort, and experience. The bottom of the pyramid is considered generic dissatisfiers, meaning if these needs are not met, it goes against

expectations. The top of the pyramid is seen as specific satisfiers, which are noticed when the journey is positively experienced. This distinction can be compared to the difference between needs and wants.

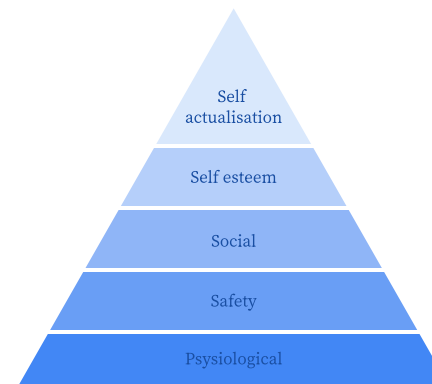


Figure 12: Maslow's hierarchy of needs. Needs lower down in the hierarchy must be satisfied before people can attend to needs higher up (Maslow, 1954).

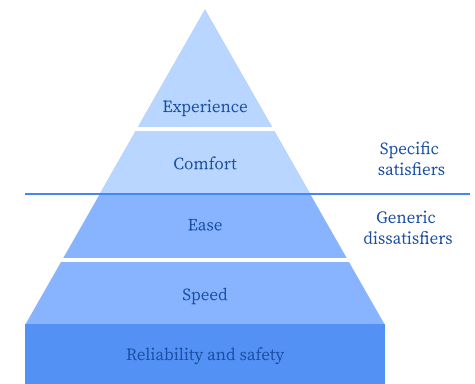


Figure 13: Quality dimensions in order of importance (Van Hagen, Peek & Kieft, 2000)

A generalised mobility system primarily addresses the general needs of people. In contrast, a personalised mobility system caters not only to needs but also to individual wants. In this project, we generally assume the following guidelines.

'Needs' can be described as the basic and fundamental aspects required to function. The interpretation of what a need is can be different for everyone. This is partly related to the degree of personal satisfaction. There is often a difference in what people think and say they need and what they actually need; perception and reality often do not align (Bhattacharya et al., 2014). For example, public transport is often seen as less convenient, less accessible, and less safe than it actually is according to measurable attributes (Kenyon & Lyons, 2003).

- *Needs are the fundament:* which elements are fundamental for someone's functioning? More specifically for mobility, this includes for example arriving on time at the location of an important appointment. Since needs have a vital role, they will be prioritised to fulfil in relation to wants.
- *Needs are general:* regardless of the type of person, needs are roughly the same for everyone. In general, there are some fundamental needs that everyone will have. Examples of psychological needs include autonomy, community, recognition and security (Desmet et al., 2020).
- *Needs are constant:* Needs endure over time and are resistant to external influences. Their inherent importance remains constant.

'Wants' go beyond the essentials and can therefore be seen as an addition to needs. Wants focus on certain preferences to improve a certain experience.

- *Wants are an addition:* wants function as an addition to the fundamental needs. If the fundamental needs are covered, wants will be considered to optimise the experience and therefore have a less vital role than needs.
- *Wants are personal:* the interpretation of wants can vary greatly from person to person. What is considered a want by a certain person can be considered a need by someone else.
- *Wants can be influenced:* Wants are more dependent on situational factors and can vary from time to time. Wants can be influenced by external factors.

However, in theory, it seems very clear. Classic examples such as water, food and shelter are clear needs. But as you move away from these, the line becomes increasingly blurred. Furthermore, applying this to a more broad sense of mobility and the context of this project adds another dimension. Generalisation refers to similarities, and a mobility system becomes feasible by focusing on these. In many cases these similarities are needs. But there can also be similarities in wants. Therefore, similarities and differences are also referred to. The terms in this report should not be regarded as hard definitions but rather as guidelines.

Fully personalised vs fully generalised mobility solutions

How does this theory unfold looking at the different areas in Rotterdam?

- *Fully personalised mobility solution:* The city will be characterised by a diversity of individualised transportation means, with a focus on the application of personal wants. To illustrate, imagine a scenario where AI automatically sends a personalised vehicle to the user, taking into account weather conditions, traffic situations, and personal preferences such as the

preferred temperature, lighting, music, and design.

- *Fully generalised mobility solution:* The city will be characterised by a minimised amount of standardised, large-scale transportation solutions, with a focus on the application of the ultimate general needs. To illustrate, consider large, self-driving buses that run on fixed routes and schedules, designed to carry as many passengers as possible at the same time.

Therefore, the aim is to strive for a balance between generalisation and personalisation. The similarities between areas are taken as a fundamental base where the differences will add some personalisation (Figure 14). The ideal sweet spot would be most personal yet feasible. Therefore, within this project, the following question will play an important role: How can you provide more personalised mobility in a generalised way?



Figure 14: The needs are broadly the same for each neighbourhood, while the specific wants can differ

2.4 Gemeente Rotterdam: Current situation and vision

Two interviews with people from 'team shared mobility' at Gemeente Rotterdam have provided an overview of the current situation and the future direction of the municipality. This includes the collaboration between mobility providers and the municipality, the current status of mobility hubs, and the efforts to personalise mobility. Mapping the current situation and the intended vision of the studied context, provides insights into relevant background information for the rest of the project. This may be different in another municipality and may affect the project's progress differently depending on the context.

Collaborating with Gemeente Rotterdam

The municipality feels responsible for the proper organisation of public spaces and for ensuring that there is space for mobility, with the right facilities and conditions. However, they rarely interfere with the market and mobility offer. This is typically the domain of market actors; policy tends to lag behind market innovations.

The municipality does have influence at another level through the APV (Algemene Plaatselijke Verordening, ENG: General Local Regulation). For example, the APV contains rules for shared transport permits, such as the number of cargo bikes that can be stationed in the city and the conditions that providers must meet. The main aim is to organise the supply and prevent clutter.

At Gemeente Rotterdam, as well as in other municipalities, there is some scepticism about the multitude of new providers. Because of the complexities involved in setting up such services, a kind of evaluation and testing process is now starting to develop. They want to assess performance and whether the providers deliver what they promise. It used to be on a first-come, first-served basis. Shared transport is now entering a new phase of maturity where it is running quite smoothly with more experienced providers such as MyWheels, Felyx, Check and Baqme.

To enter this market, a provider needs to carefully consider the use cases and user groups in the city that are currently underserved by mobility. Which groups are large enough to focus on? What can be offered to these groups to improve their travel experience? A provider must truly complement the current system.

Current state of mobility hubs

Rotterdam, along with other Dutch cities, is actively working on the development of hubs. On behalf of the Ministry of Infrastructure and Water Management, the Province of Zeeland and five major municipalities (Amsterdam, The Hague, Eindhoven, Utrecht and Rotterdam), a national identity for shared mobility hubs has been developed. This features standardised parking spots with tiles indicating the type of shared transport (Figure 15). This uniformity across cities enhances recognition and accessibility (Mijksenaar et al., 2022). Gemeente Rotterdam indicates that these hubs, along with the use of geo-fencing, primarily focus on preventing clutter. However, there are plans to increase the hub offer and thus build a network with hub types in different scales. These hubs will offer a wide range of mobility services as well as a variety of additional facilities.

Additionally, the municipality is involved in behavioural approaches. On one hand, this aims to promote proper usage of shared mobility, while on the other hand, it aims to encourage its use. What options are available? How do you use them? How can we assist people? What are the barriers people encounter in the usage process? There are ideas on how to address these issues per neighbourhood. However, this approach focuses on encouraging the use of shared mobility based on the characteristics of each neighbourhood rather than considering the initial needs and wants of its residents.



What does the municipality already do in the field of personalisation?

The municipality monitors through surveys and reports in various ways, both specifically for Rotterdam and on a national level. At the moment there's no reflection per neighbourhood and all vehicles are deployed citywide based on supply and demand to determine their placement. There are rules in the APV, but they mainly concern quantities and how they are managed.

Although they mention it is interesting to focus more on area specific aspects, there hasn't been time to look at neighbourhood-specific solutions. However, the municipality has recently started working with neighbourhood councils and neighbourhood agreements. If a neighbourhood expresses a desire for more shared mobility, an expansion of service areas, or is interested in the placements of hubs, this request is forwarded to the central mobility department via the neighbourhood agreements and it will be arranged accordingly.

The municipality is currently in the early stages of the spectrum between personalisation and generalisation. The current approach leans heavily towards a market model, where the market assesses supply and demand. The municipality has some influence, but ultimately it is the commercial provider who needs to understand what the user wants.

There is an idea to focus more on neighbourhood-specific needs. Data collection and analysis play an increasingly important role. Gemeente Rotterdam collects a lot of data, but still has little insight into it. Work is underway to integrate and link the information so that it can actually provide valuable insights that can be used for policy-making. Ultimately, the aim is to develop dashboards from which usage can be derived, but this is still seen as a major challenge.

Deelvervoer		
Deelvervoer 	Deelfiets 	Elektrische deelfiets
Deelbakfiets 	Deelauto 	Elektrische deelauto
Deelbusje 	Deelscooter 	Elektrische deelstep



Figure 15:
Current hubs in Rotterdam and style layout (Mijksenaar et al., 2022)

Dijkzigt/Nieuwe Werk, Feijenoord and M4H Phase I

3.1 Introduction

Diversity is a fact in Rotterdam. Looking at the people, there is no strong majority in any population group (Gemeente Rotterdam, 2021). The city has a long history of immigration, resulting in a mix of cultures and backgrounds. Furthermore, Rotterdam is also diverse in terms of infrastructure and physical elements (Figure 16). As mentioned in the contextual research, the city is built around cars. However, other factors such as the division of the city by the Maas, the accompanying bridges and tunnels, the presence of the port of Rotterdam, and major facilities like the Kuip and Ahoy also play a role. These are all factors that can differentiate the mobility related values in a particular area.

To reflect the diversity of mobility needs and wants within a city as clearly as possible, three areas are selected as contrasting as possible. With three areas, the research remains somewhat manageable while still exploring the complexity of variation. This involves looking at what is already known around influencing factors in modality choices, particularly in the context of hubs for shared mobility. What factors influence which modalities are suited in a hub at the relevant location? These can be factors that focus on the characteristics

of the users in that area, as well as factors related to physical properties of the concerned area. The greatest possible diversity in these factors will lead to a diverse range of mobility needs and appropriate mobility. Since Louwman Group is interested in gaining more insights into how suitable modalities can differ for different users, it is relevant to set up this difference within the context of Rotterdam as extreme as possible.



Figure 16: Artwork at the Bas Jungeriusstraat, picturing Rotterdam's diversity and different faces. Translation: "Queen of the Maas. Rotterdam, the city of bridges, the tunnel, the ships, the quays, the cranes, De Kuip, and 'no words but deeds'. Anyway, let it be nice." (Boute, 2022)

3.2 An urban focus: area scope and scales

In order to select the areas to be studied, it is first necessary to determine the scope within which this selection will be made. Is it particularly interesting to include the suburbs of Rotterdam or to rather focus on the city centre only? Then, it is necessary to decide on what a suitable area scale is for this project.

Area scope

For Louwman Group, the emphasis in this project is mainly on urban areas. Due to the greater variety of different values in cities, it is more interesting for this project to focus on urban mobility. When looking at hubs, there are many different types, including those on the outskirts of the city or outside the city. For Louwman Group, however, it is particularly interesting to focus on mobility and hubs located in the city centre, among people. Appendix A discusses which types of hubs fall within and outside the scope of the project.

Because of this urban focus, the scope of the areas to be investigated is set within the so-called 'Ruit van Rotterdam' referring to the Rotterdam ring road (consisting of the A20, A16, A15, and A4), pictured in Figure 17.

Area scales

As described in the contextual research, personalisation vs generalisation is an important theme in this research and is also relevant in choosing area scales. Whether the focus is on city-level, district-level, neighbourhood-level, or even street-level, will have an impact on the outcomes. The area framework set up by Gemeente Rotterdam, consisting of districts and neighbourhoods, will be used in this project since most retrievable quantitative data is also available at this level. An example is illustrated in Figure 18 (Gemeente Rotterdam, 2022a). The complete overview of the districts and neighbourhoods within the Rotterdam Ring can be found in Appendix B.

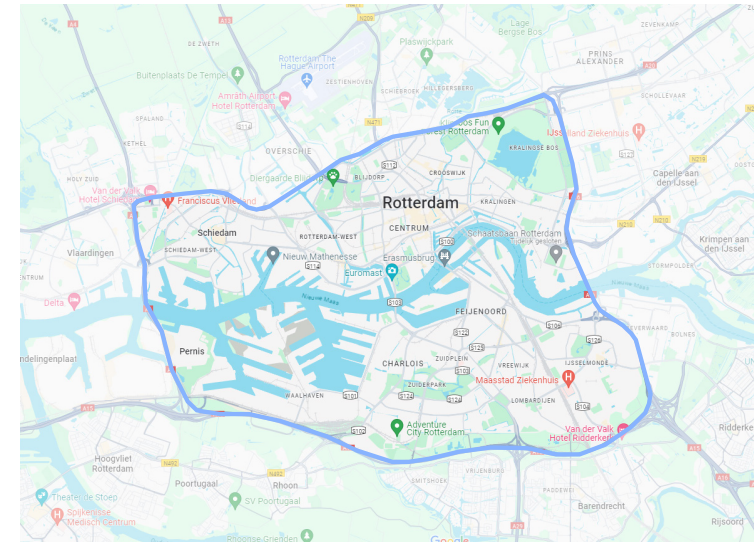


Figure 17: The ring road of Rotterdam, the so called Ruit van Rotterdam

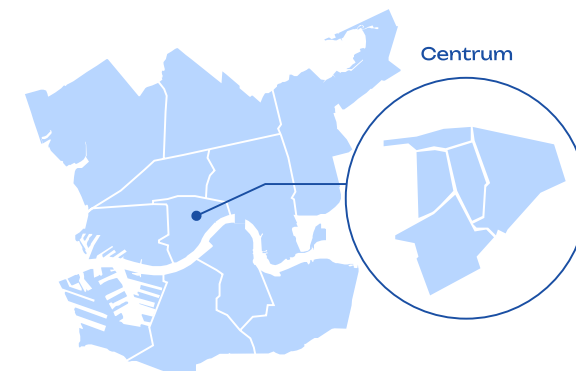


Figure 18: Area scales. Rotterdam divided into districts (left), e.g. district 'Centrum' divided into neighbourhoods (right) (Gemeente Rotterdam, 2022a).

Louwman Group is interested in getting more and better insights into the values of future users to offer the most fitting mobility solution. Therefore, focusing on a smaller and more personalised scale aligns better with Louwman Group's goal. However, the scale should not be too zoomed-in since that would be unfeasible in terms of over personalisation. Rotterdam's diversity is decisive in this field. The 'wijkprofielen' (neighbourhood profile) is an overview set up by Gemeente Rotterdam to show how the different districts and neighbourhoods score in terms of social, physical and safety aspects. The scores are based on both measurable facts and figures as the experience of the citizens (Gemeente Rotterdam, 2022a). Despite the fact that those profiles may not directly represent the differences which are mobility wise relevant to this project, it does give a first glance on the diversity in neighbourhoods. For instance, the neighbourhood profiles of Hillesluis en Katendrecht in district Feijenoord show how neighbourhoods within the same district could differ (Figure).

Within the scope of this project, practical factors for location determination are not considered. So based on the explanation above, focusing on neighbourhoods fits best within the scope of this project. However, to keep the analysis manageable, the area comparison is first made at district level, after which the most 'extreme' neighbourhood within this district is selected. In Appendix B an overview can be found of the districts and neighbourhoods relevant to this project. The districts and neighbourhoods outside of the ring road of Rotterdam are therefore excluded.

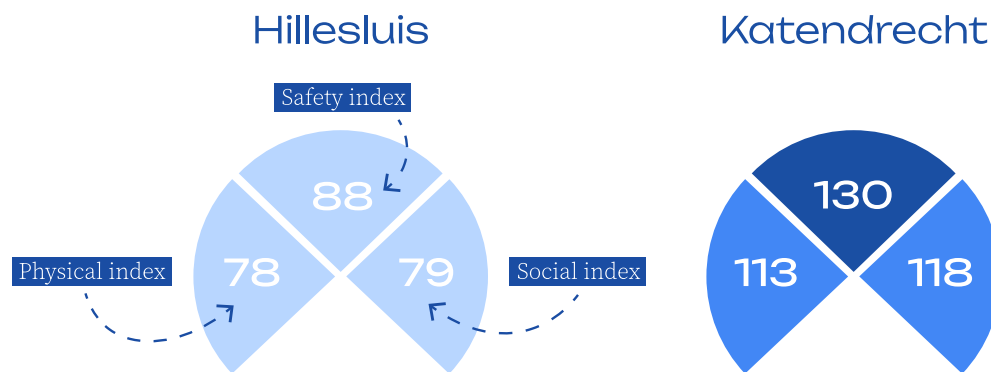


Figure 19: Scores of Hillesluis and Katendrecht, both in district Feijenoord, on physical, safety and social aspects. The index score ranges from a minimum of 0 to a maximum of 200. A score of 100 corresponds to the city average at the time of the baseline measurement in 2014. This index score is calculated for all neighbourhoods (Gemeente Rotterdam, 2022a).

3.3 Fostering diversity in area selection

The criteria for selecting the neighbourhoods aim to achieve the greatest possible difference in mobility values and fitting solutions. Related to this are the choices people make when it comes to mobility. What factors influence these decisions? The focus in setting up these criteria is on analysing what is already known in order to use this as a starting point.

Relevant factors influencing modality choice and hub modalities

Modality choice and hub modalities are not the only relevant factors in determining mobility needs and wants, but they can serve as a good starting point. Based on Lee et al. (2022), influencing variables on the modal split, the share of daily trips made by each travel mode, can be categorised into three factors; environmental, socio-demographic, and planning variables when comparing cities. The environmental factors are mostly climate-related and virtually uncontrollable. Socio-demographic factors are semi-controllable since it takes quite some time to change and can only be done by higher-level policies. Planning variables are relatively more controllable and involve city planning and policies. Since only Rotterdam is analysed in this study, the environmental factors can be neglected as no differences are noticeable on this scale. Additionally, many planning factors are also the same within a city.

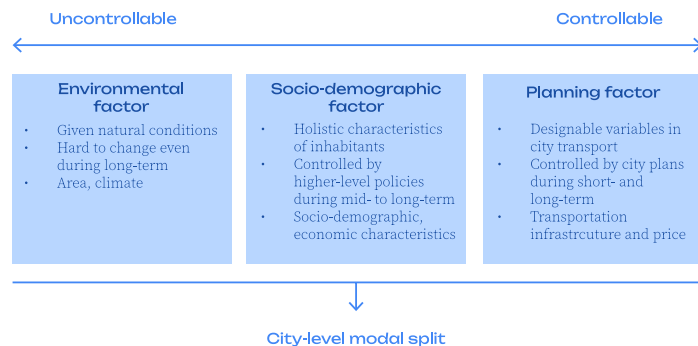


Figure 20: Relevant variable categories influencing modal split based on their controllability: environmental, socio-demographic, and planning factors. Environmental factors are not relevant in this study (Lee et al., 2022).

Based on those categories, the influencing factors are divided into factors based on the users and factors based on the location and integration. Since some factors are strongly related, not all factors can strictly be positioned in one of those categories. According to (Lee et al., 2022), socio-demographic variables, especially the elderly and young rates, have the largest impact on the modal split. The planning factors are a logical consequence of the socio-demographic variables in a city and are therefore strongly related.

Factors mainly based on user characteristics

1. Car ownership

- Santos et al. (2013) present a literature overview of different factors influencing mode choice and modal split. The overview suggests that car ownership positively associates private car use and negatively associates public transport use. A part of the literature also suggests that car ownership negatively associates bicycle use.
- If the car use is high, it is advisable to consider whether other modes in the area can be made more attractive than the car. The hub can be used as a way to get cars off the streets. Sometimes access to a car or bus is essential, a shared car or bus could possibly be a solution (Kandel et al., 2022).

2. Income

- Higher income positively associates private car use and generally negatively associates public transport use (Santos et al., 2013).
- People with higher incomes usually have more social activities and travel therefore more frequently (Giuliano & Narayan, 2003). This tendency often motivates them to own cars.
- Kandel et al. (2022) state that in an area with many people on modal incomes or below, the hub should offer affordable shared mobility or, for example, a place where people can borrow or get a bike. In an area with many people on modal incomes or higher, they suggest considering whether it would be useful to offer different types of modalities in addition to basic affordable models, and facilities such as a coffee bar.

3. Age

- *Young people*
 - Children's choice of travel modes is predominantly influenced by their families due to the constraints of shorter travel ranges and limitations in driving ability. Families often prioritise safe travel modes for their children (McCarthy et al., 2017).
 - Teenagers (15-20) are generally well-versed in digital platforms and systems. This group often does not have a driving licence. Offering modalities in the hub that do not require a driving licence is a better fit for this group (Kandel et al., 2022).
- *Middle aged*
 - Middle-aged people generally are more likely to afford a car. Also, they tend to travel more frequently for social activities, resulting in a stronger preference for private car ownership (Ding et al., 2017).
 - Twentysomethings (20-30) often do not yet have their own car and are often used to using public transport and/or shared mobility. Communication and the offerings of the hub should be designed in such a way that this group does not feel the need to own a car and is less inclined to transition to personal car ownership in later stages of life (Kandel et al., 2022).
- *Older people*
 - A higher age positively associates private car usage and negatively associates public transport use, bicycle use and moving by foot (Santos et al., 2013).
 - Due to physical restrictions and fewer daily activities, seniors have shorter travel ranges and frequencies than younger people. Their mode choices are also related to family situation, income, physical capability and neighbourhood environment (Alsnih & Hensher, 2003).
 - Older people are often less familiar with digital platforms and systems. This should be taken into account when developing a hub. Elderly also have specific needs and wants, for example preferring a shared e-bike over a regular shared bike (Kandel et al., 2022).

4. Household composition

- Households with children are positively associated with private car usage and negatively with public transport usage (Santos et al., 2013).
- In areas with many families with children, Kandel et al. (2022) suggest offering 'specials' suitable for families in the hub, such as cargo bikes and prams, in addition to affordable basic models.

Criteria mainly based on location and integration

5. Population density

- Higher population density is positively associated with public transport usage and negatively with private car usage (Santos et al., 2013).

6. Land use mix

- A more land-use mixed area is negatively associated with private car usage and positively associated with public transport usage, bicycle usage and moving by foot (Santos et al., 2013).
- Related to the land use mix is the type of travellers. Travellers can be divided into residents, visitors and commuters. Depending on the facilities and land use in an area, it can be roughly deduced what the proportion of these types of travellers is within the area. Visitors include, for example, visitors for companies, tourist sites, residents or events. Commuters include, for example, working people or students. Different types of travellers will have different needs and wants (Kandel et al., 2022).

7. Mobility quality

- Demand for bicycles, both shared and owned, positively correlates with the associated infrastructure, such as bike paths and docks (Eren & Uz, 2020).
- The accessibility in an area can be described as the opportunities to use transportation. This can be quantified by looking at the densities of transportation facilities; the number of stations divided by the territorial area (Lee et al., 2022).
- Higher public transport service frequency is positively associated with

public transport usage and negatively with private car usage (Santos et al., 2013).

8. Transformation degree

- Kandel et al. (2022) suggest what the implications for a hub in an existing area, transformation area, and development site will be;
 - Existing area: a hub in an existing area where no area development is taking place. In this case, current users of the area should be assumed.
 - Transformation area: a hub in an existing area undergoing area development. In this case, it needs to be assessed to what extent the transformation of the area will lead to new users.
 - Development site: a hub in a newly developing area where area development is taking place. In this case, future users of the area should be considered. Close contact with the area developer should be maintained.

Translating factors into criteria

The factors above can be translated into criteria by formulating them in such a way that as much diversity as possible is desired within this factor. For each factor, it was considered what data is available for each relevant district and neighbourhood to make the criteria measurable. The details of the data used for each criterion can be found in Appendix C.

- *Diversity in demographic factors*: age, income, household composition
- *Diversity in types of travellers*: residents, visitors, commuters, main facilities
- *Diversity in current mobility use*: registered vehicles, car density
- *Diversity in development plans*: existing area, transformation area, new area
- *Diversity in mobility quality*: Public transport offer

3.4 A glimpse into primary area characteristics

The available data for the relevant districts and neighbourhoods is collected in an overview. Based on the established criteria, extremes are sought on as many fronts as possible within this overview. This will result in three contrasting neighbourhoods.

Selection process

The data for each relevant district and subsequently for each neighbourhood was collected and can be found in Appendix D. The selection process was simply based on trial and error until a profile of three contrasting areas based on the criteria emerged. By gathering the data for each relevant district, a rough choice of two contrasting districts was made. This showed that in many fields there was a noticeable contrast between the district Feijenoord and Centrum. From this point, the neighbourhoods within those districts which represent those differences most extremely were selected; Feijenoord (neighbourhood) and Dijkzigt/Nieuwe Werk. Within these two neighbourhoods was still a clear noticeable difference missing in terms of area development and was also the elderly age group underrepresented. The future neighbourhood M4H (also known as Merwe-Vierhavens or Nieuw Mathenesse), with a sub-focus on elderly, therefore fits well into this profile. In addition, a wide range of financial income is targeted within M4H, from social housing to more expensive owner-occupied properties. As a result, this neighbourhood is a well-suited addition to the other two neighbourhoods.

Basic area profile

With the data collected, a basic profile of each neighbourhood can be drawn up which roughly reflects the differences (Table 1).

Table 1: Overview of the selected areas with a short description of each criteria

	Dijkzigt/ Nieuwe Werk (Centrum)	Feijenoord (Feijenoord)	M4H (Delfshaven)
Demographic factors	Relatively more young adults, single households, couples without children High income	Relatively more children, families, single-parent households Low income	Relative focus on elderly, small families couples without children or children moved out Ranging from social housing to more expensive owner-occupied housing
Types of travellers	Relatively more visitors/ commuters Facilities: Erasmus MC, Museumpark, Het Park, Euromast	Relatively more residents Facilities: no main facilities, but close to de Kuip	Relatively more residents and commuters Facilities: cultural hotspots and innovative/creative companies
Current mobility use	Relatively medium car density	Relatively high car density	Car free area vision
Development plans	Existing area: no high-impact development planned	Transformation area: a lot of new housing projects and a new city bridge	New area: radical transformation of a port area into a residential/work area
Mobility quality	Metro, bus, tram, waterbus, Erasmusbrug, Maastunnel	Train, bus, waterbus, train station Rotterdam Zuid	Currently metro, tram, bus, waterbus. Plans for a car-free neighbourhood based on shared (micro) mobility

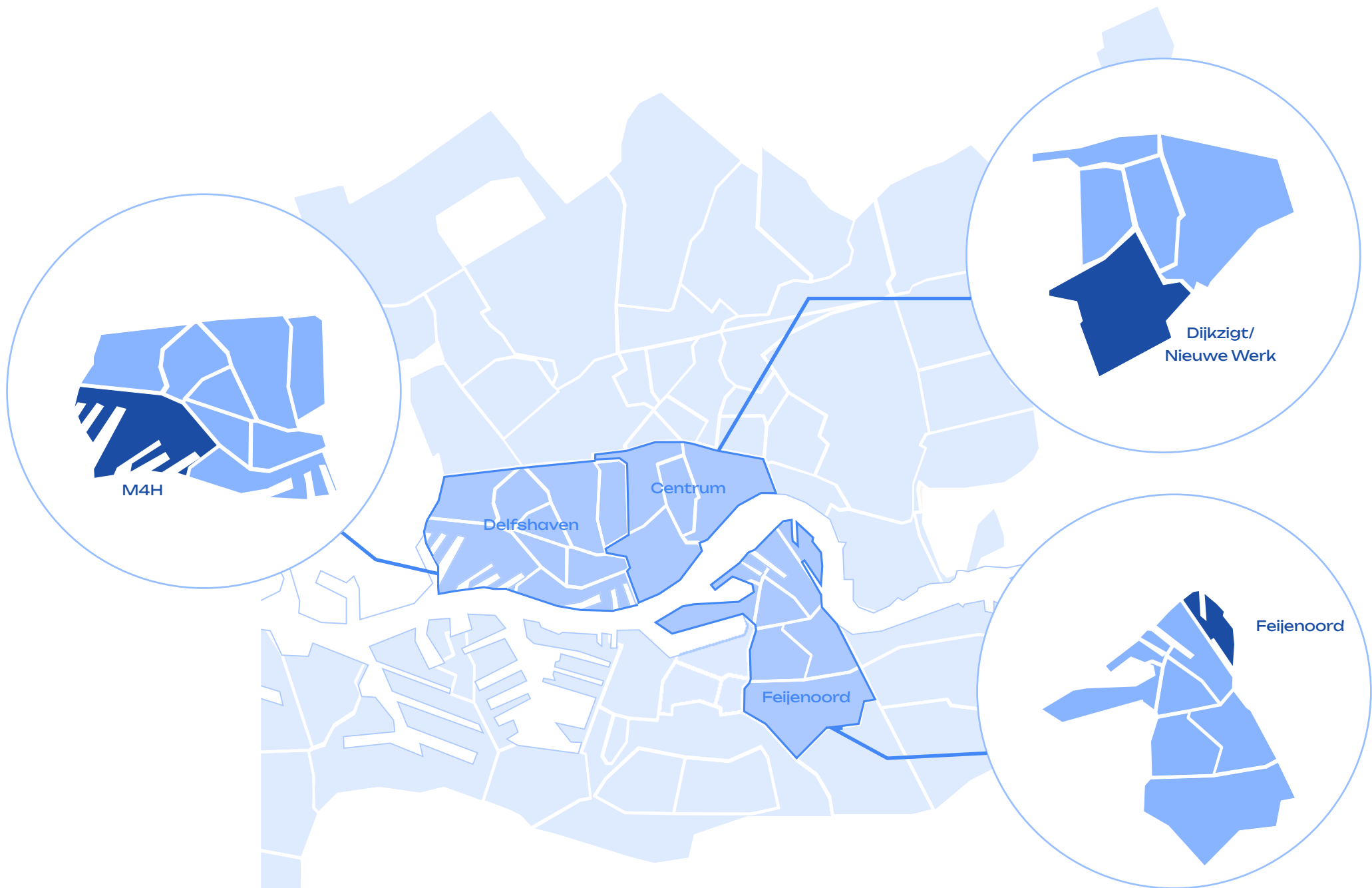


Figure 21: The neighbourhoods Dijkzigt/Nieuwe Werk in district Centrum, Feijenoord in district Feijenoord and M4H in district Delfshaven

3.5 Conclusion and evaluation

Conclusion and follow-up steps

Three contrasting neighbourhoods were selected from the first phase: Dijkzigt/Nieuwe Werk, Feijenoord and M4H. The criteria for the selection of these neighbourhoods were derived from existing research on factors influencing modal choice and hub effects. By combining existing research and the available data for each neighbourhood within the Rotterdam ring, a basic understanding of each district, and subsequently each neighbourhood, could be illustrated, enabling the selection of the most contrasting combination. The result of this first phase is a basic neighbourhood profile for each of the three neighbourhoods. This knowledge gives basic insights and serves only as a starting point for the rest of the project.

In Phase II, research will be carried out for each neighbourhood in order to delve deeper. The focus will be on finding qualitative additional information to the data from Phase I, to explore what lies behind the numbers. What is the atmosphere in the neighbourhoods? What kind of people live there? What is their life like? What do they value? What are their concerns? The aim of this in-depth research is to gain an insight into the underlying needs and wants.

Approach limitations

The available research on which the criteria are based has generally not been very fruitful. Some initial hypotheses could not be confirmed (or debunked) by the available research.

The Dutch mobility culture is very specific. For example, due to the numerous bicycles. Therefore, some parts of studies with the context of foreign cities cannot be directly applied to the case of Rotterdam. Literature that focuses specifically on Dutch cities could provide very different insights. In the next phase, however, this will come to light through own conducted research.

Some factors would have been useful to involve in the selection process, however, this data was often not available for every neighbourhood in Rotterdam. For instance, regarding current modality choices, the available data was primarily about cars.

When selecting the three neighbourhoods, all districts were first compared in order to keep it manageable. Then, the most 'extreme' neighbourhood was selected for each district. This may have influenced the choice of neighbourhoods. In a more comprehensive study, this could be avoided by directly comparing all neighbourhoods without the intermediate step at the district level.

The neighbourhood selection in this study was based on trial and error. However, in order to do this in a more careful way, an appropriate data analysis method that deals with both numerical and more qualitative data could lead to a more substantiated result.

Scalability remarks

Firstly, it must be said that phase I in this process is probably not a phase that would realistically be executed. The aim of this phase in this research is to present a wide range of mobility values within the same city. Depending on the results, this may reinforce the importance of addressing wants. However, in reality, other factors are more likely to play a role, such as the degree of mobility shortcomings.

The area scales need to be considered per specific case. For this research, it was decided to make comparisons at neighbourhood level rather than district level because there can still be significant differences within a district in Rotterdam. However, this may vary depending on the area of research. It could also be carried out at a larger scale (city level, more generalised focus) or smaller (street level, more personalised focus) scale.

Furthermore, the relevant criteria may vary from case to case. When comparing cities, differences in certain planning factors and regulations are also relevant. For example, the price of an hourly ticket for public transport may vary.

Out into the neighbourhood

Phase II

4.1 Introduction

In Phase I, three contrasting neighbourhoods were selected. This selection was based on a set of criteria aimed at selecting the areas with the most diverse mobility values. From the data collected, we now have a basic idea of each neighbourhood. For example, we know some demographic information, which types of travellers are particularly relevant, elements of the current infrastructure and influential facilities. However, further research is needed to gain a deeper insight into the needs and wants of these neighbourhoods. This will primarily focus on qualitative research to understand what lies behind the static data collected in the first phase. Ultimately, the aim of this research is to answer the research question:

What are the (mobility) values of travellers in Dijkzigt/Nieuwe Werk, Feijenoord and M4H?

In order to find out, several sub-questions will be used as a guide. These do not all have to be answered concretely, but rather serve as a framework for the research. After all, part of the research is to be surprised by the environment and the people who use it.

- What is the atmosphere like?
- What are the habits?
- What are common activities?
- What are common trips?
- What kind of lifestyle do people have?
- What mode of transport is commonly used for which activities and why?
- What do people consider important when making choices?
- How dependent are people on the car?
- What are the frustrations and problems?
- What do people worry about?
- Do people sometimes feel constrained?
- Do people think about the future?
- Do people make decisions based on habit or rationality?
- What do people really need?



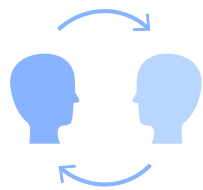
Figure 22: Observations in Feijenoord

4.2 Tackling mobility habits and uncovering deeper values

Before a research approach can be developed, it is necessary to consider what the focus of the research will be. How do you address the fact that people tend to act quickly out of habit? How do you find out what people really need? This chapter explores the relevant theory that will serve as the basis for the research approach.

Attitudes towards new mobility

People don't always choose the most logical option when travelling from A to B. Think of the quickest, most convenient or least expensive route. Personal feelings and biases strongly influence decision-making. People tend to prefer their usual habits. Even when they are faced with facts to the contrary, and even when a particular choice is made more attractive by a discount. People are influenced by social norms and cognitive biases when making decisions, preventing them from making choices based on functionality or utility. Therefore, for many citizens, the car still remains the most desirable option, even when alternative mobility might suit their lifestyle and inner preferences much better (Hazan et al., 2020).



Social (or cultural) norms

- Rules or expectations regarding behaviour and attitudes based on shared beliefs of a specific cultural or social group.
- Examples: symbolic-affective motive (buying a personal car upon obtaining a driver's license and achieving financial independence)



Behavioural (or cognitive) biases

- Systematic ways in which the human mind deviates from rational choice theory
- Examples: confirmation bias (focusing on information that supports one's preconceptions) and status quo bias (finding it more comfortable to keep things as they are)

Figure 23: Human behaviours that influence attitudes toward new mobility
based on Haselton et al. (2015) and Lapinski and Rimal (2005).

However, Rotterdam's future vision, just like the general trend of many cities, aims to increase the attractiveness of the city and create a more healthy and liveable city by reducing the prominent role of the car in the city. Therefore, people will need to become less and less attached to the car and be more open to alternatives to stay mobile in the city.

What is holding back the adoption of new mobility options?

Status quo bias: people tend to stick to the familiar due to the comfort it brings. Change requires mental effort, known as cognitive load. Car use is an ingrained habit. Switching to alternative modes of transportation, especially for daily commutes, adds cognitive load, making it challenging compared to the perceived convenience of driving your own car. The default is often to maintain the habit, even if more sensible or environmentally friendly options exist (Hazan et al., 2020).

Halo effect: the halo effect occurs when positive qualities are magnified, overshadowing the negative aspects and resulting in an overall positive judgement. In the context of car ownership, drivers often concentrate on the perks, such as individuality and freedom, while downplaying critical drawbacks like high gas costs and time spent in traffic (Hazan et al., 2020).

Ambiguity effect: the presence of various alternatives typically leads to avoiding options with uncertain outcomes. Car drivers, for instance, prefer familiar risks like regular weekday traffic over unfamiliar ones such as the potential breakdown or irregular schedules of public transportation. On top of that comes the illusion of control, where people tend to overestimate their influence on external events, such as traffic congestion. This effect can also be applied to the adoption of flexible carpooling services, as the initial ride does not guarantee a return trip or an uncertain travel time to pick-up/drop-off other passengers (Hazan et al., 2020).

Fear of the unknown: new mobility modes are often unfamiliar and approached with caution. A study by Pestour (2019) found that 38% of non-users considered free-floating e-scooters dangerous, against 18% of the users.

Anchoring bias: In Decision-making, individuals often heavily rely on a single piece of information, known as anchoring, typically the first information they encounter. This tendency can impede the adoption of new mobility modes. For instance, someone might hear about an e-scooter collision and generalise that these vehicles are universally unsafe. Similarly, a negative initial experience, such as difficulty finding a charging station, might dissuade someone from using a shared electric vehicle again. While new mobility services are inherently novel, they come with expected challenges. Despite significant improvements in service quality for most modes, some individuals may anchor on an initial negative impression, letting it shape their final judgement (Hazan et al., 2020).

Make habits impossible

One way to change mobility habits is by removing the known way. Larcom et al. (2017) studied the effects of the London Underground strike of February 2014. Many commuters were forced to experiment by exploring new routes. The strike brought about some lasting changes in behaviour, as one in 20 stuck with their new routes after the strike was over. An interview was conducted with Pieter Jan Stappers, author of Convivial Toolbox and contextmapping expert. He suggests:

“By making something impossible, people have to start thinking about a new solution. And by starting to think about possible alternatives and which ones you would choose, you can become aware of the reasons why you do something.”

- Pieter Jan Stappers

This is an interesting motive to use as a base for researching the mobility needs and wants in a certain area. This way, you force people to think about the pros and cons of certain modes of transport, and avoid giving preferences based on habits.

How to identify deeper layered values?

Contextmapping is a method focused on understanding the context in which people live. It is a suitable base to gain in-depth insights into the lifestyle, daily activities, and related specific needs and wants. A participatory approach, where the targeted users are involved, helps with creating a holistic picture that takes local knowledge and experiences into account. The interview with Pieter Jan Stappers helped to give direction to the use of elements of contextmapping in this project.

As described in Convivial Toolbox (Sanders & Stappers, 2013), Knowledge can be identified in 4 levels; explicit knowledge, observable knowledge, tacit knowledge and latent knowledge (Figure 24).

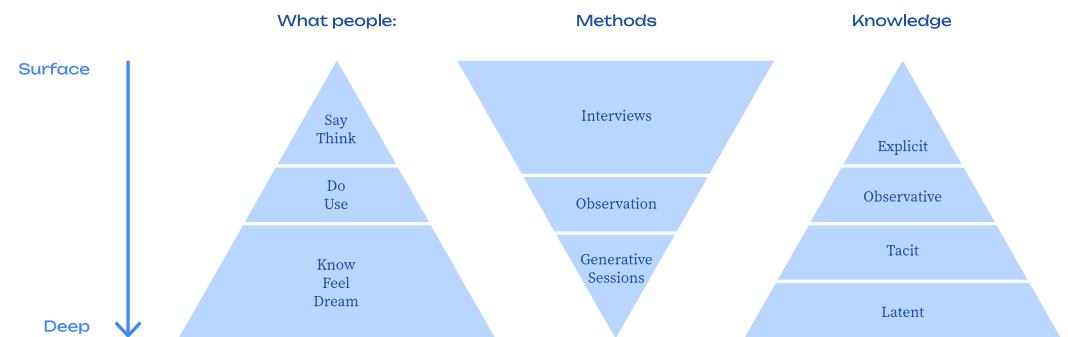


Figure 24: The layering of different types of knowledge (Sanders & Stappers, 2013)

As described earlier, people tend to act according to habitual behaviour. So in order to gain insights into what people actually (consciously or unconsciously) prefer, deeper layers of knowledge should also be investigated. These types of knowledge are often more challenging for people to communicate. Generative design research tools and techniques function as a base to gain insights in those tacit and latent levels. However, since the deeper layers of knowledge are also more difficult for people to express, an approach is needed that slowly builds up (Sanders & Stappers, 2013).

However, according to Sanders and Stappers (2013), a generative study should almost always be used in combination with methods focusing on more explicit and observable types of knowledge and is, therefore, a combination of information regarding what people say, do, and make (Figure 25).

- *What people say*: involves allowing people to communicate their thoughts and opinions, often by interviews and questionnaires.
- *What people do*: involves observing people, their activities, the objects they use, behaviours, etc.
- *What people make*: involves having people to create something to express their ideas

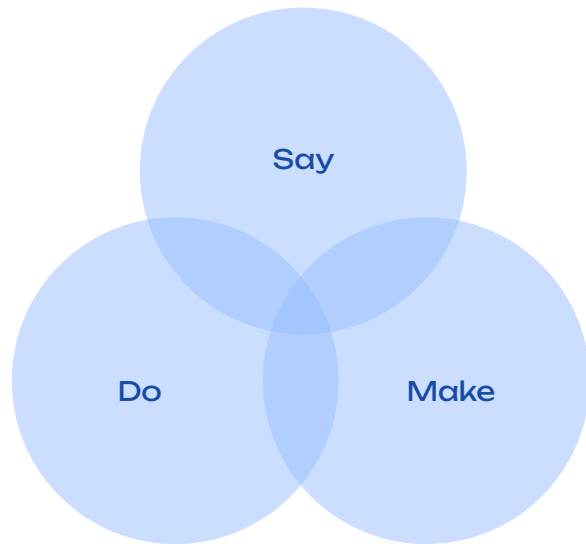


Figure 25: A combination of Say, Do, and Make tools and techniques complement each other (Sanders & Stappers, 2013).

4.3 Approach to observations, surveys and interviews

Using the above background information as a common thread, a research approach was drawn up in which all three elements Say, Do, and Make are represented. Below describes the final approach of this study after some considerations and iterations were done. Those iterations are described later in the chapter. The approach for M4H slightly differs from the other two neighbourhoods and is therefore described in Chapter 4.4.

Observations

Doing observations aims to obtain information about what people Do. This is the first step in the research process. The aim of the observations in this study is not to count specific actions, or observe a specific crossroad for example, as is often the case. In this exploratory study, it is interesting to dive more into the atmosphere, culture and habits of the area. In doing so, it also serves as a way to surprise yourself and find out things you hadn't thought of beforehand. This information can then be applied in the survey or interviews, thus making it useful to start with this part. The areas are walkable in terms of size, allowing each area to be observed in sufficient detail. While observing, attention was paid to i.a. the people, their habits, significant facilities, atmosphere, infrastructure, modality ratios, and above all, leave room for surprising yourself. Data was collected in the form of photographs and notes.

Survey

Conducting a survey aims to obtain information about what people Say. This is the second step in the research process. Through the survey, relative to the interviews, the aim is to cover as much of the entire neighbourhood as possible to draw representative conclusions. The survey distinguishes the different groups of travellers; residents, commuters, and visitors. Via a flyer with a QR code, the survey is distributed throughout the neighbourhood (Figure 27). By putting the flyers in the mailboxes in the neighbourhood, residents are targeted. And by handing out the flyers on the street to passers-by, commuters and visitors are targeted. This way,

all three groups are involved in the study. By using simple language, and providing a Dutch and English version, efforts are made to make the survey as inclusive as possible. Furthermore, I tried to make the times of handing out flyers as diverse as possible (week/weekends, dayparts).

Using a combination of closed and open-ended, quantitative and qualitative-oriented questions, information is collected on topics such as their daily activities, mobility values, dependence on the car, concerns and demographic information. Some questions are adapted based on the relevance to the travel target group. The survey can be found in Appendix E.

Interviews

Lastly, the interviews aim to obtain information about what people Make. Where the survey already touched a little on 'making habits impossible', the interviews are more focused on this element and integrate elements of generative research. The interviews serve as a qualitative addition to the information gathered from the survey, potentially debunk biased assumptions, and broaden perspective. Interviews can still reveal things you overlooked in the survey and allow you to dive deeper by asking follow-up questions. The main interest is not on collecting a completely representative picture of the whole district, like the survey, but more on collecting additional district-specific information. Since in Feijenoord the more predominant traveller group is the residents, the interviews were done with this group. In Dijkzigt/Nieuwe Werk, the more relevant groups are commuters and visitors.

The 'Day in the Life' exercise serves as a suitable basis to identify people's deeper values. This exercise is appropriate for this research as activities, modalities, and values are clearly linked. The layering approach in this exercise is effective because if people are asked to identify a single positive or negative event and its reason, it would be too complex to answer. It is a fairly simple exercise and lends itself well to being performed verbally in a low-key way. This is important since if the exercise is

too complex or lengthy, people are more likely to drop out. As described in Convivial Toolbox (Sanders & Stappers, 2013), the ‘Day in the Life’ exercise consists of three steps:

1. Create a layer of facts by describing the activities/events in a specific day
2. Create a layer of valence in which high and low points are identified by expressing which activities/events were perceived as enjoyable and less enjoyable
3. Create a layer of needs and values by Identifying the reasons for each high and low point

To shape this technique more towards the purpose of researching mobility-related values, the exercise has been modified. Additionally, the element of ‘making habits impossible’ is integrated into the exercise. Within the layer of facts, the used modalities are added. Subsequently, for each modality the highs and lows are asked for in relation to the activity or situation. Then, the reason for those highs and lows is asked. Next, the participant is asked to imagine a situation where the chosen modality would be unavailable. For example, if the participant would go to the market by bike, but the tire turned out to be flat, how would the participant go to the market and why? Removing a habit forces the participant to consider the pros and cons of modalities, and stimulates the emergence of underlying values (Appendix F).

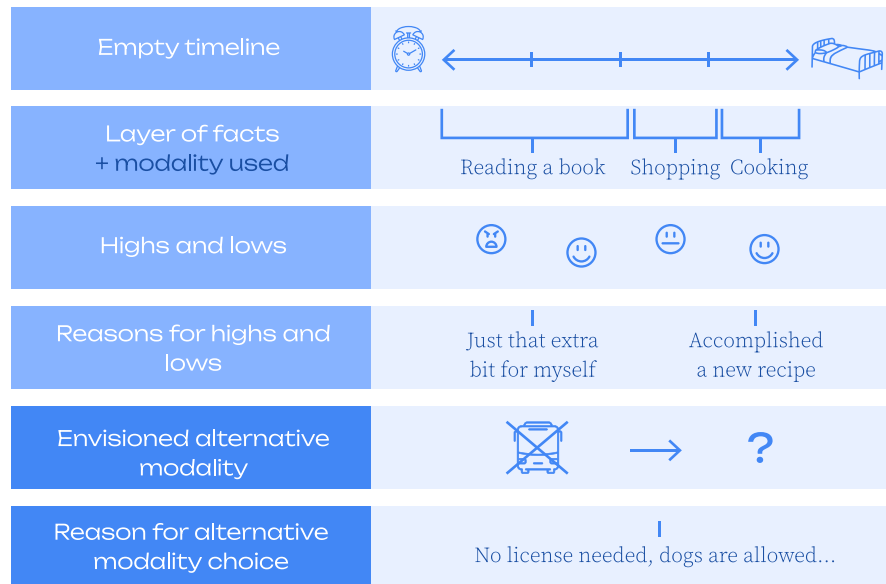


Figure 26: The ‘Day in the Life’ exercise is a technique to dig for needs and wants

Suitable transport for everyone in Rotterdam

Research on the mobility needs in **Dijkzigt en Nieuwe Werk**

Your perspective is very important to gain a better understanding of the mobility needs and preferences of the people in Dijkzigt and Nieuwe Werk! Looking towards the future, we are looking for diverse insights to form a realistic picture of how people move or would like to move around our city. Your experiences and opinions will help us find solutions that can improve mobility for everyone.

Draai om voor Nederlands



Scan the **QR code** with your phone or visit the link to participate in our short survey. Thank you in advance for your help!

<https://forms.gle/YhXe8ES8KkudK6Vr5>



Figure 27: The Dijkzigt/Nieuwe Werk version of the flyer. The backside shows the Dutch version.

4.4 Mapping values in M4H: an approach to future areas

Researching future residents and users requires a different approach for an area that is undergoing a complete transformation. The current residents and users are not representative of those who will eventually live, work or visit here. This chapter describes the approach taken to map the values of the relevant travellers in M4H.

Exploratory observation

An exploratory observation is a way to explore the area in its current state. Despite the many changes to come, the developers aim is to preserve the raw character of the port and industry. In addition, certain buildings and elements will remain but will be repurposed, such as the Ferro gas holder (Figure 28). Similarly, many of the current manufacturing companies will be retained. The atmosphere of creativity that the project developers wish to preserve can be sensed through exploratory observation. However, the true raw character of the area will inevitably be somewhat lost. The purpose of the observation is to get a sense of the unchanged elements and to imagine what the future situation might look like. The degree of preservation might differ for each new area, so the value and purpose of an exploratory observation may vary from case to case.

Reports

For M4H, a considerable number of reports have been published on the plans for the area. ‘Het Ruimtelijk Raamwerk’, for example, translates the vision of Gemeente Rotterdam en Het Havenbedrijf into a spatial and programmatic plan for M4H. This framework consists of both concrete principles and directional ambitions in terms of the programme, building structure, mobility plan, outdoor space and materialisation (Gemeente Rotterdam et al., 2019). From this, a mobility strategy (Gemeente Rotterdam et al., 2022), a future vision for the industry and companies (Gemeente Rotterdam & Havenbedrijf Rotterdam N.V., 2022) and a masterplan for the Merwehaven area (Gemeente Rotterdam, 2023b) have been developed. These reports

paint a picture of the future situation in M4H. However, it remains difficult to draw a representative picture of the mobility values of future users with these reports, especially as they present an ambitious and almost utopian vision that overlooks doubts or potential problems.

Interview Gemeente Rotterdam

After reading the reports, several questions remained unanswered. Apart from general descriptions of the target groups, it was not entirely clear who would be using the area and what their needs and wants would be, especially with regard to the concept of a car-free neighbourhood. Therefore, an interview was conducted with Gemeente Rotterdam to gain more insights. This interview focused primarily on the municipality’s approach for identifying the future users and their values, as well as the main challenges of the current plan. It was not possible to obtain more content-related information about the research. The interview insights, along with a description and evaluation of their approach, can be found in Appendix G.



Figure 28: Current state and envisioned idea for the Ferro gas holder by DELVA Landscape Architecture Urbanism (2019)

4.5 Field research execution and first impression

The research has generated a huge amount of data. This chapter provides an insight into the research conduction and presents some of the raw data findings. The data will be systematically analysed in Phase III to distil the relevant and useful information after which the area profiles for each neighbourhood will be presented. This chapter therefore only provides preliminary insights into the research and its conduction.

Dijkzigt/ Nieuwe Werk

Figure 29 shows a selection from the photographs taken during the observation of Dijkzigt and Nieuwe Werk. This selection highlights various facilities, recreational opportunities and the business-oriented and affluent aspects. The survey was distributed through mailboxes and on the streets, resulting in 57 respondents (Figure 30). Visitors and commuters were also interviewed on the street. A total of 7 interviews were conducted, some quotes are presented. The interviewees included work commuters, students, museum visitors and EMC visitors. Diversity among the interviewees was achieved by conducting interviews in different locations and at different times (weekdays/weekend).



Figure 30: Overview of the Dijkzigt/Nieuwe Werk survey respondents

“I go by car mainly for comfort. I drive electric because I do think it is important to think about the future.”

“From Rotterdam CS, I started walking; it seemed like a nice walk through the city.”

“Since I am in a wheelchair, I have to use adapted transport specifically designed for wheelchair users.”

“We do almost everything by bike. We also think it is important to be outside with the children and teach them that cycling is healthy.”

“We prefer transport that we can use together”



Figure 29: Impression of the observation session in Dijkzigt/Nieuwe Werk

Feijenoord

Figure 31 gives an insight into the observation in Feijenoord. It shows the atmosphere of the neighbourhood, its decay, the types of (social) facilities, and the contrast with the newly built area in the neighbourhood. The survey was distributed through mailboxes and on the street, resulting in a total of 36 respondents, mainly residents (Figure 32). In addition, residents of the neighbourhood were interviewed at 'Sociaal Café onder de Oranjeboom'. This is a social initiative that serves as a meeting place for people from the neighbourhood. As well as providing meals for those who cannot afford it, serves as a place where people can get advice or take language lessons. Some quotes from the eight interviews are shown on the right. The interviewees represent a group with low disposable income, older age and experience various personal limitations.

“I walk and cycle a lot because it means I am exercising at the same time”

“When it rains I just put on a rain suit, that’s just the way it is”

“The pavement is often bumpy, this makes it difficult to drive my mobility scooter”

“I don’t need more than my bicycle because everything is close by”

“I find it scary to go by car, I prefer public transport”

Survey total: 33 respondents



25 residents



4 commuters



4 visitors

Figure 32: Overview of the Feijenoord survey respondents



Figure 31: Impression of the observation session in Feijenoord

M4H

Figure 33 shows a combination of photographs taken while observing the current state of the neighbourhood, and images used by the project developers to illustrate the vision for the area. The project developers aim to transform the raw character of the neighbourhood in a new and accessible way. Given the length of time it will take to develop the area, the neighbourhood will continue to exist for some time as a mixture of its current and intended state.



Figure 33: Impression of the observation session in M4H and the envisioned plans.

Reuse of data from Dijkzigt/Nieuwe Werk and Feijenoord for M4H

Through the research conducted in Dijkzigt/Nieuwe Werk, some relevant information can be reused and applied to M4H. The interview with the municipality revealed that in some areas the plans are indeed too ambitious. There is still a need to investigate how the plan will be inclusive enough. The municipality requires that 20% social housing will be included in the area, but the current system is not inclusive and feasible enough. People with lower disposable incomes might not have completely different needs and wants but do have limited opportunities. If shared mobility becomes the norm in the neighbourhood, it must also be affordable for all. Additionally, elderly are also a specific target group in the plan for which such an innovative shared mobility system should be usable. In the current mobility strategy, these people fall through the cracks. Moreover, many questions arise regarding the car-free aspect of the neighbourhood. There are numerous situations that create mental barriers. What if I suddenly need to go to the hospital? What if I need to move? How do you make sure you don't miss the car in such situations? By incorporating these shortcomings and doubts into the ambitious plans outlined in the reports, a more realistic picture can be drawn.

Expert Interview Beer Pijpker (Fietsschool010)

In addition to the observations, surveys and interviews, an interview was also conducted with cycling teacher Beer Pijpker from Fietsschool010, an initiative that provides cycling lessons in Rotterdam (Figure 34). During this interview, Beer provided valuable insights into the mobility limitations people experience and how learning to cycle has given many a sense of freedom. The information and anecdotes from this interview are not specific to any particular neighbourhood, as the cycling classes are offered to people all over Rotterdam. However, most of the information is particularly relevant to the situation in Feijenoord and can therefore be applied most effectively there. Some interesting anecdotes from the interview can be found in Appendix H.

“ You really have to think of the term “cycling happiness”. When I first heard it, I thought, aren’t we exaggerating a bit? But no, it’s true. The feeling when you hop on your bike on a Sunday morning, not entirely sure where you want to go, and then you veer off a bit, and then a bit more. That’s when you end up in places you’d never otherwise visit. That’s the ultimate feeling of freedom and living.”

- Beer Pijpker (cycling teacher)



Figure 34: Cycling lessons at the Marconistraat by Fietsschool010 (Gemeente Rotterdam, 2024)

4.6 Conclusion and evaluation

Conclusion and follow-up steps

Phase II aimed to gather more detailed information on the values of the relevant travellers in the three neighbourhoods following the research question:

What are the (mobility) values of travellers in Dijkzigt/Nieuwe Werk, Feijenoord and M4H?

This was investigated using various research methods, which resulted in a wealth of data and information. Chapter 4 provides a brief insight into this. However, in order to adequately answer the research question, the data must first be thoroughly analysed in order to translate them into needs and wants. This will be done in Phase III. The full overview of results per neighbourhood is also presented in this chapter in the 'Area Profiles'.

Approach iterations and considerations

Before the research approach took shape in the way described in this chapter, several iterations preceded it. Below are some considerations in this process.

Observations: Initially, it seemed beneficial to carefully plan the observations beforehand. The idea was to conduct exploratory observations to determine what might be interesting to analyse during the main observation. However, after this preliminary round, it became apparent that there wasn't much utility in observing certain things in a structured quantitative manner. It is not about what occurs most frequently, but rather about what holds value. Therefore, a simple guideline with a few focus points works best, allowing sufficient room for surprises.

Separate generative sessions: What is the ultimate added value of a separate, standalone generative session in this study? To determine this, the costs and benefits of a generative session had to be considered. Organising such a session would entail a

significant amount of time and practical complexity. How do you ensure people are willing to participate (without financial compensation)? How do you reach these people? How do you have them work with a synthesising booklet beforehand? It is certainly worthwhile to consider this, but within the scope and timeframe of this study, it would become too complex. It could have still been possible to recruit people via the survey to participate in a generative session (by leaving an email address), but the interest turned out to be not sufficient and consistent across all neighbourhoods. Ultimately, by pinpointing precisely what information was needed, it was found that this information could be obtained through interviews incorporating elements of generative sessions.

Day in the Life exercise: There are infinite possibilities when it comes to tools and techniques for delving into deeper levels of knowledge. Another interesting approach is to have people create a collage with a piece of paper and trigger stickers about how they experience their journey, and then explain these further. They then create a second collage on an overlay about their desired experience. However, this is less effective for a diversity of trips and modalities. Because the 'Day in the Life' exercise clearly connects activities, pros and cons, and associated values, this technique is better suited for this research. Additionally, some practical factors would hinder this process, such as creating collages on the street in wind and rain not being ideal. Furthermore, it is not a very accessible approach, which might scare people off.

Approach limitations

Throughout the process, there have been some limitations and contributing factors that may have influenced the results. By being mindful of these, the results can be appropriately interpreted. Below are some limitations of the research approach and execution:

- People without a smartphone cannot scan the QR code. Despite the presence of a link on the flyer, this may still prevent some people from completing the

survey. Additionally, conducting the survey online will exclude a group of digitally illiterate people who are nonetheless important to include in this research (especially since digital platforms will increasingly become part of mobility).

- Despite the survey being available in both English and Dutch, people who are not proficient in either of these languages will be excluded. Once again, this is a group of people who are particularly interesting to target. By keeping the language as simple as possible whenever feasible, an effort has been made to accommodate this as much as possible.
- To obtain representative data, the information collected from the participants' demographic details in the survey should ideally be scaled to match the actual ratio and representation of the neighbourhood. This approach would allow for a more realistic depiction.
- Looking at the results, it was noticeable in Feijenoord that it was mainly older people who completed the survey. This may be due to the fact that they have less busy schedules and therefore take the time to fill in a survey.
- It was snowing during part of the survey. This may have affected the results. In addition, part of the research was conducted just before the holidays. This could also affect mobility patterns, as many people travel to visit family during this time.
- Despite efforts had been made to vary the research moments (days, times), there could have been more variation. For example, no research was conducted in the evening.
- The people that were interviewed in the 'Sociaal Café onder de Oranjeboom' are a specific group of people who are generally older and have a low disposable income. These people are not fully representative of the neighbourhood as a whole. Initially, an attempt was made to interview people on the street, but hardly anyone was open to conversation. However, it is a valuable addition to those who completed the survey, as it allowed me to speak to people who may have been missed by the survey (such as people who are digitally illiterate).

Evaluation of the approach for future areas

There are many ways to approach future areas. For this project, however, time and information was limited. Having access to more information from the outset allows for opportunities to approach this. Ultimately, the approach proved to be effective for this project, but may not be consistently applicable to other neighbourhoods. By incorporating information about inclusivity from other neighbourhoods into M4H, it was possible to address the limitations of the current mobility strategy. However, this may not always be a realistic approach. In addition, the information gathered from the other researched neighbourhoods, although relevant in this case, may not always be available or applicable.

It is also possible to filter the data collected from other neighbourhoods based on the intended types of household composition for example. This was tried initially, but in this case it did not give any clear insights. Perhaps on a larger scale with more data this approach could be effective.

Recommendations and scalability remarks

To ensure the scalability and reproducibility of the research approach, several recommendations should be considered:

Standardising procedures: The research procedures should be standardised as much as possible to ensure consistency across cases.

Financial compensation: It is advisable to explore the possibility of distributing surveys with financial compensation. Distributing hundreds of flyers per neighbourhood resulted in a response rate of about 10%. Offering financial compensation could be an effective way to increase participation and collect richer data.

Group interviews: Organising interviews on a larger scale and as group sessions can be considered. However, it is important to consider whether discussing issues in groups adds value or whether an individual approach works better.

Collaborating with partners: It is advisable to carry out research in cooperation with other relevant parties, such as the municipality, Huizen van de Wijk or the Hogeschool Rotterdam. They could provide access to networks to reach certain target groups.

Ethical considerations: A comprehensive plan for ethics should be developed, especially on a larger scale. Issues should be addressed such as how to handle large data collections, or how to ensure that participants are treated respectfully by all parties involved. It is important for Louwman Group to be associated with confidentiality and credibility.

Iterative improvement process: Each different case is likely to bring new iterations and improvements to the process. There needs to be room to keep making these iterations to keep optimising the approach.

Common ground and unique traits

Phase III

5.1 Introduction

Phase II focused on conducting in-depth research on the three neighbourhoods. A wealth of information was gathered from observations, surveys, and interviews with travellers and experts, with some data immediately appearing more useful than others. In this chapter, the information is systematically synthesised to filter out interesting and relevant information for this project and to provide an overview of the data collected. By comparing the information, differences and similarities can be identified and used as a basis for identifying needs and wants. Area profiles will then be developed for each area to guide the ideation phase.



Figure 35: Data clustering

5.2 From raw data to insightful themes

This chapter illustrates how themes are developed for each neighbourhood based on all the data collected. This is done using a Thematic Analysis. This is then used as a basis for identifying differences and similarities.

Data analysis approach

By first labelling all the information collected using a Thematic Analysis, sub-themes can be identified. Under each theme, statements, findings, figures, observations, etc. are categorised. These sub-themes are then clustered into several main-themes per neighbourhood. These themes are included in the area profile.

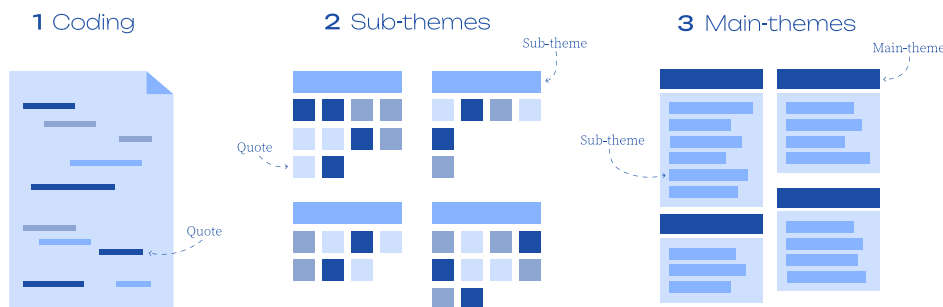


Figure 36: Overview of the steps in analysing the results

Labelling and creating sub-themes

Thematic analysis is used to analyse the information collected. Thematic analysis involves identifying, analysing and documenting themes in qualitative data (Braun & Clarke, 2006). The information collected consists of a mixture of quantitative and qualitative data, but is predominantly qualitative. Due to the different research techniques used and the different types of information gathered, it is important

to use a method that allows flexibility in interpretation. Thematic analysis offers flexibility in interpreting information and makes it relatively easy to process large amounts of data by identifying themes. It is, however, a fairly subjective method that is susceptible to interpretation and bias.

What qualifies as a theme does not depend on how often it occurs in the dataset; just because something occurs more often does not mean it is more important. Braun and Clarke (2006) argue that determining relevance involves the researcher's own interpretation. It is primarily about whether something is important in relation to the research question. But what is relevant in this study? Mobility needs are very broad. Therefore, there is no strict definition of what to look for in the data. Things that are not immediately related to mobility are still included, as general information can indirectly lead to relevant topics. This approach tends to be inductive and latent (Braun & Clarke, 2006). Inductive thematic analysis, as opposed to theoretical thematic analysis, focuses on the emergence of themes from the data without preconceived ideas. Latent themes, in contrast to semantic themes, focus on exploring underlying ideas. To provide some guidance during labelling, the following broad research question has been formulated:

What are aspects relevant to keep in mind while thinking of fitting mobility solutions?

In doing so, the connection to mobility was kept in mind, but interesting data does not necessarily have to be directly linked to it. Various data inputs have been used for labelling. An overview can be found in Appendix I. Besides that, relevant sub-themes from Feijenoord and Dijkzigt/Nieuwe Werk are also included into the overview of M4H. These are sub-themes related to the lack of inclusion of low incomes and elderly in the strategy. The sub-themes can be found in Appendix J.

Creating main-themes

Once all the data has been labelled and thus categorised into sub-themes, these sub-themes are grouped again into main-themes. Many of the sub-themes are related in some way. The main-themes are not directly used for identifying wants, but rather function as an intermediate result that gives a good picture of the area. The grouping was first self-executed, but in order to avoid bias and to discover other patterns, this process was also done by three fellow students with different backgrounds in Industrial Design Masters programmes. There were different approaches to the grouping, such as:

- *Types of travellers:* e.g. luxurious traveller, limited traveller, fun traveller
- *Users of (and reasons to use) a certain type of transportation:* e.g. shared mobility, public transport, private car
- *Cause and effect:* e.g. high income > open to mobility options, restricted citizen > ignorance of mobility options
- *Conflicts and contradictions:* e.g. limited VS unlimited traveller, positive attitude VS negative attitude
- *Subjects:* e.g. neighbourhood atmosphere, infrastructure, social mindset

By analysing these different approaches to grouping, a final arrangement could be made, which is a combination of different approaches. The final arrangements can be found in Appendix K. Due to the diversity of the data, it is also logical that not all connections can be made in the same way. The main-themes are explained in the area profiles in Chapter 5.6, 5.7 and 5.8.

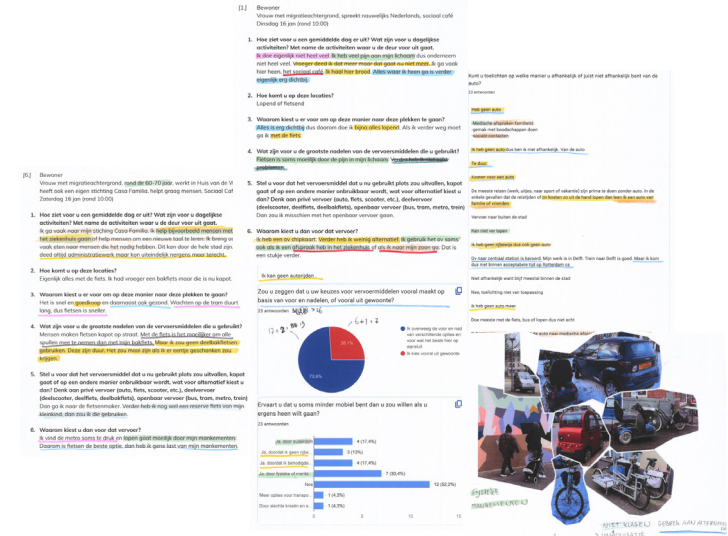


Figure 37: The process of labelling the gathered information



Figure 38: Fellow students clustering the sub-themes into main-themes

5.3 Identifying differences

Then, based on the sub-themes and themes, scales of extremes are established. The three neighbourhoods are plotted on these scales. These scales serve as a basis for mapping the differences between the neighbourhoods. From the position of each neighbourhood on each scale, the focus can then be zoomed in to the sub-themes and the corresponding labelled information. This information is then used to formulate specific wants for each neighbourhood.

Creating scales

After identifying sub-themes and main-themes, scales can be established. Contrasts and extremes are sought within the main-themes and sub-themes. These extremes are translated into axes on which the three neighbourhoods are plotted. The aim is to map the differences between the neighbourhoods and thereby identify the specific wants for each neighbourhood. These axes can be divided into personal factors (related to the people) and external factors (related to the area). Examples include: “conservative vs. open to innovation”, “individual autonomy vs. community centric”, “feeling of isolation vs. feeling of connectivity”. The scales can be found in Appendix L. This step is the first moment in the process where the different neighbourhoods are coming together to compare.

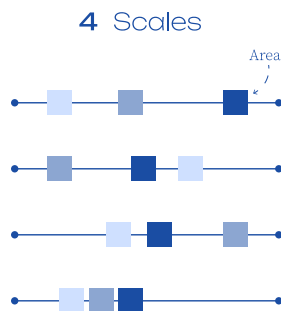


Figure 39: Setting up scales with extremes

Translate scales to needs/wants

Beneath the position of each neighbourhood on each scale lies certain collected information to support its position. By linking the relevant sub-themes with their corresponding data to the position of the neighbourhood on the scale, wants can be formulated from here. Thus, by first zooming out, an overview can be created to understand the general differences. Then, by zooming back in, the transition to specific wants can be made. The specific wants per area are presented in the area profiles in Chapter 5.6, 5.7 and 5.8. An example of this process can be found in Appendix M.

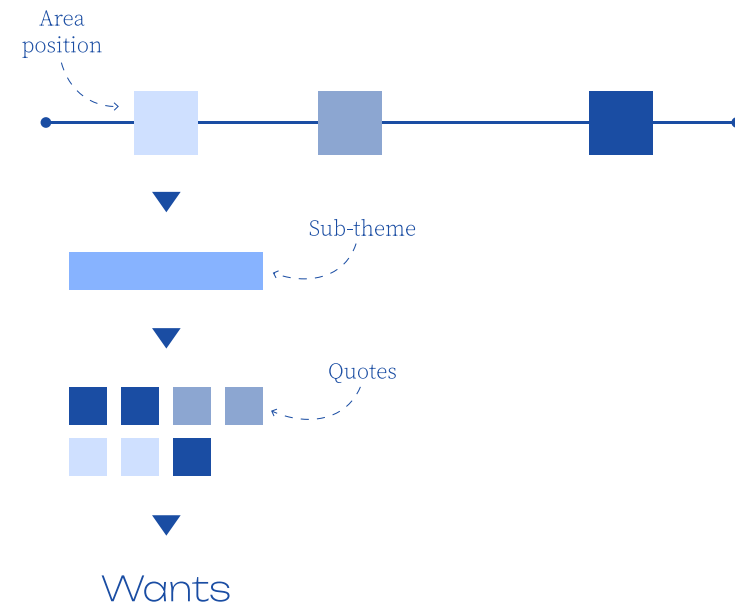


Figure 40: Zooming in to translate the position of each area to wants

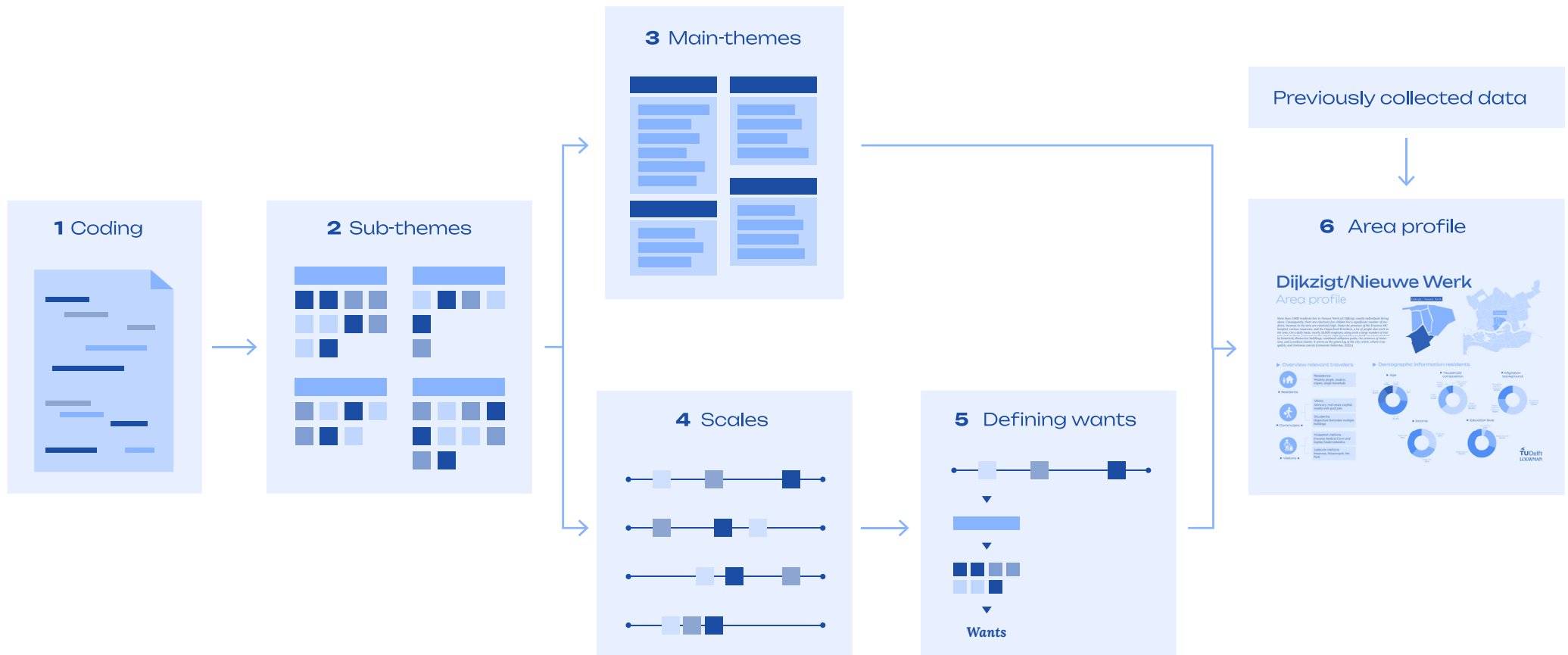


Figure 41: Overview of the steps in analysing the results

5.4 Identifying commonalities

As well as identifying the differences between neighbourhoods, it is also important to explore the similarities. This can serve as an overarching generalising element that allows the concept to address feasibility (Figure 42). The mapping of similarities between neighbourhoods was done in three different ways. First, overlaps in responses were identified from the survey. Then, a further step was taken to look for overlap within the sub-themes, which gave the similarities a bit more depth. Finally, attention was also paid to the context of Rotterdam and the related characteristics of its citizens in terms of mobility and character in general. Each approach provides insights into similarities in a different way, although one may be more useful than the other.

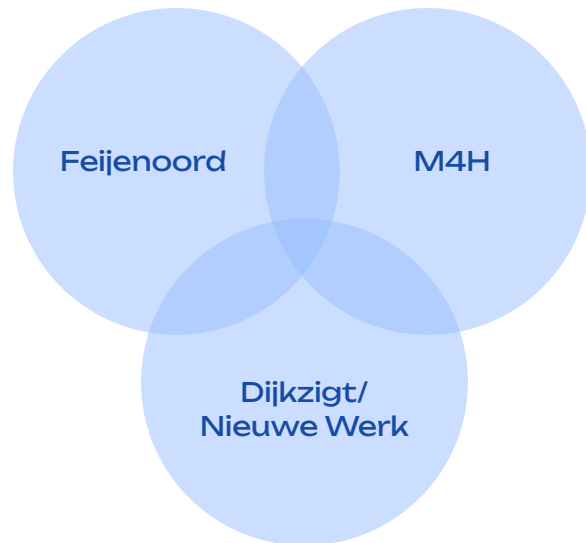


Figure 42: A similarity within all three districts has the potential to serve as a basis for the concept

Survey results

Within the survey results, similarities between neighbourhoods can be identified. The survey revealed some overlap in responses, particularly in the multiple-choice questions. These similarities are therefore rather superficial. These included similarities in: activities, used types of transportation, mobility related values, problems experienced, interest in new mobility solutions, concerns.

A selection of common needs has been identified, mainly based on common values. These are items that turned out to be generally important to everyone in these three neighbourhoods:

- Travel time
- Costs
- Well-matching departure/arrival times
- Minimal walking
- Not too many transfers or switching between modes of transportation

These values primarily translate into fundamental focus points that the concept ideally addresses. The other similarities in the survey results can be found in Appendix N.

Similarities in sub-themes

The sub-themes were also used to identify similarities. The main-themes are too broad for this purpose. In addition to the similarities between the three districts, I also found many similarities between two districts. However, for this project, the similarity between all three districts is essential. While the common values from the survey result in more tangible needs, the sub-themes provide similarities at a slightly deeper level. This can serve as a more interesting basis for a concept. In all three areas there is a noticeable presence in different ways:

- Physical disabilities
- Desire for mobility freedom
- Reliability
- Travelling together
- Inclusiveness

Another way to identify similarities in themes is by setting up scales with the intention of also finding similarities. However, this results in a very large number of scales, which can lead to a loss of overview. The similarity of the lack of inclusion of vulnerable groups emerged by chance when setting up the scales, but can also be inferred from the similarities mentioned above.

Context specific: Rotterdam

Finally, there are similarities in the fact that all three districts are located in Rotterdam. What are the elements that characterise Rotterdam and are generally applicable to all travellers? This has been divided into the perspective of Rotterdammers (Rotterdam citizens) on mobility and a more general profile that characterises the Rotterdammer.

The omnibus survey investigates how Rotterdammers think about mobility (Gemeente Rotterdam, 2023b). Some insights:

- For years, traffic congestion has been one of the top three problems that Rotterdammers say should be tackled as a matter of priority. Traffic congestion remains the top issue, as it was last year.
- Measured car ownership = 59%. In the long term, this figure is rising steadily.
- 12% of the Rotterdammers do not own a car or a bicycle.
- 70% use a car at least once a week as a driver or passenger.
- In the short term (since 2015), there seems to be a slight and gradual decrease in the perception of road safety (both on the roads, in the neighbourhoods and in the city centre).
- When asked about traffic nuisances, the antisocial behaviour of car drivers

appears to be by far the most annoying, with almost half of respondents being very annoyed by it. Mopeds and scooters are often a source of considerable annoyance, especially how and where they drive.

Besides the view on mobility, the mindset and characteristics of Rotterdammers was also investigated. In 2013, Museum Rotterdam asked hundreds of Rotterdammers what they consider to be typically Rotterdam, in search of the Rotterdam feeling with the exhibition: “ECHTE ROTTERDAMMERS - wie denken we wel dat we zijn?”. From all these responses, several core characteristics were identified: rough, real, direct, honest, loyal, modern, hardworking, foreign roots, daring, and the Rotterdam approach (Museum Rotterdam, 2013). More details can be found in Appendix O.

5.5 Key findings: an overview of each area

All the relevant information collected is brought together in the Area Profile. This provides a comprehensive overview of each neighbourhood, incorporating different types of information relevant to mapping the mobility needs and wants. Below is a brief explanation of each component of the neighbourhood profile, followed by the profiles themselves.

Area profile set up

Introduction

The introduction provides an overview of basic information about the neighbourhood. What are the distinctive aspects of the neighbourhood? What are the landmarks or notable features of the area? What is the general atmosphere of the area?

Location

A map shows the location of the neighbourhood within Rotterdam and indicates the district to which the neighbourhood belongs.

Overview relevant travellers

In this project, the relevant travellers in an area are categorised as residents, commuters and visitors. These categories also include sub-groups which could have different interests within the category. For example, among visitors, a distinction can be made between those visiting for leisure and those visiting for a medical appointment.

Demographic information

In Phase I, neighbourhoods were partly selected based on a diversity of demographic characteristics. The profile provides an overview of age distribution, household composition, migration background, income and education level. The profile for M4H is still unknown. However, there are intended proportions in the price segments of the houses and several target groups are identified that are to be attracted to the area and for whom the houses will be most suitable.

Development

The level of planned development is expressed as an 'existing area', a 'transformation area' or a 'new area'. Certain developments can affect how the neighbourhood will look, what the people are like, what facilities will be available, and what types of travellers will be relevant. By predicting the impact of these changes, adjustments can be made accordingly.

Travel journeys

For each target group, the most relevant journeys are described. Although it is difficult to generalise, this overview gives an idea of where people come from and where they go for what purpose.

Area specific wants

The identified wants, are also included in the area profile. For the sake of clarity, the needs are roughly grouped.

Themes

The themes outlined in Chapter 5.2 provide a brief explanation of the key points derived from the research phase. These themes, combined with illustrations, paint a clear picture of what is going on in the neighbourhood.

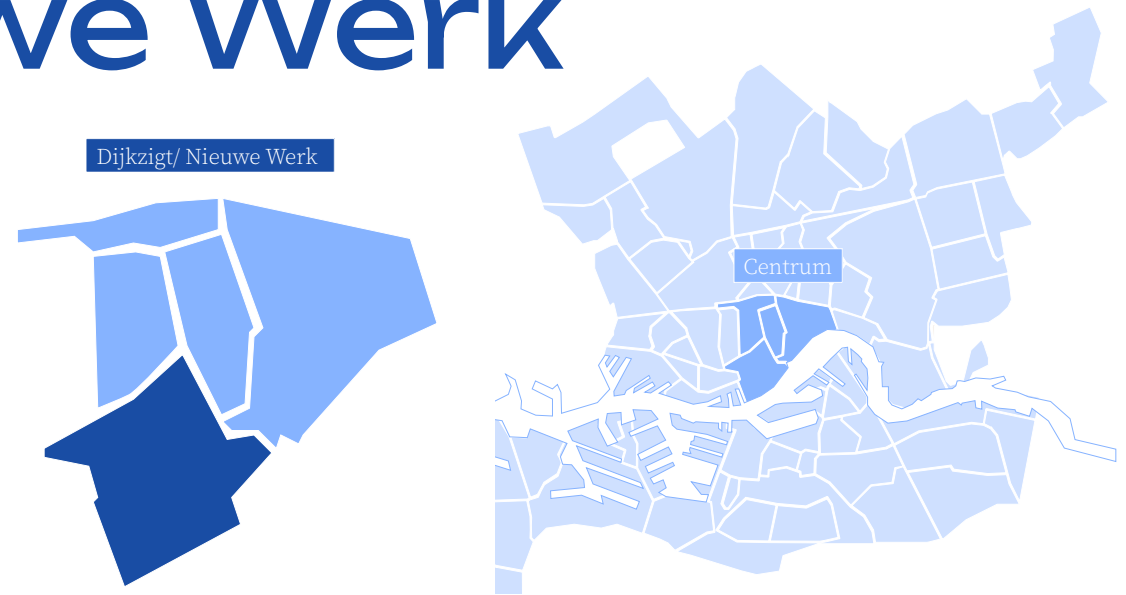
Collages

Finally, the collages provide an illustrative guide to interpreting the information. Photos taken during the observations are grouped into relevant themes, giving visual representation to the descriptions of the neighbourhood.

Dijkzigt/Nieuwe Werk

Area profile

More than 2,800 residents live in Nieuwe Werk and Dijkzigt, mostly individuals living alone. Consequently, there are relatively few children but a significant number of students. Incomes in the area are relatively high. Due to the presence of the Erasmus MC hospital, various museums, and the Hogeschool Rotterdam, a lot of people also work in the area. On a daily basis, nearly 20,000 employees, along with a large number of visitors and students, commute to the region. Dijkzigt and Nieuwe Werk are characterised by historical, distinctive buildings, combined with green parks, the presence of museums, and a medical cluster. It serves as the green lung of the city centre, where tranquillity and liveliness coexist (Gemeente Rotterdam, 2022c).



► Overview relevant travellers



Residents

Wealthy people, students, expats, single households

► Residents



Work

Advocacy, real estate, hospital, mostly well-paid jobs

Students

Hogeschool Rotterdam, multiple buildings

► Commuters ★



Hospital visitors

Erasmus Medical Center and Sophia Kinderziekenhuis

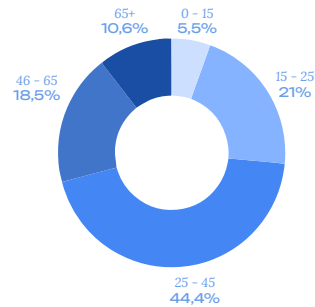
Leisure visitors

Museums, Museumpark, Het Park

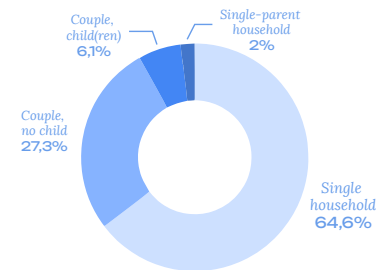
► Visitors ★

► Demographic information residents

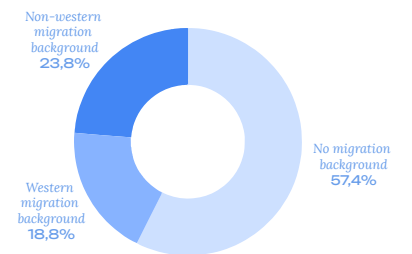
► Age



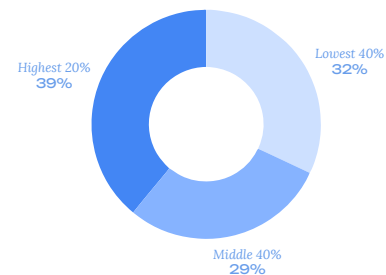
► Household composition



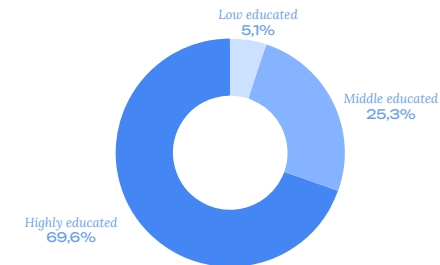
► Migration background



► Income



► Education level



▶ Development degree



Museumpark

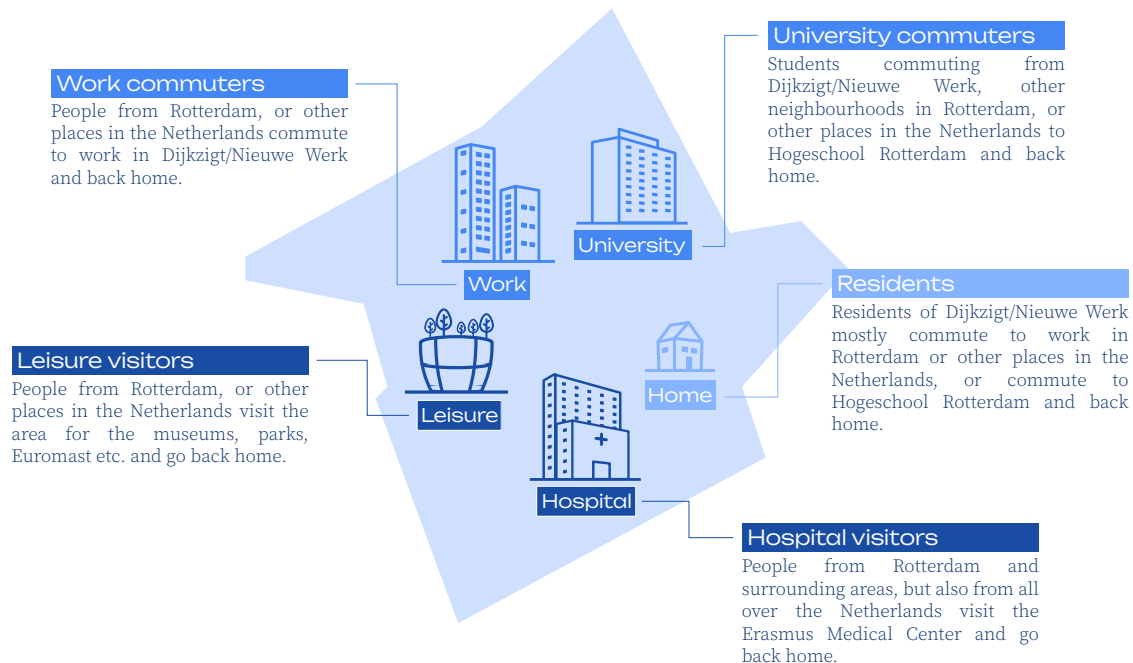
Not many major developments are planned within the neighbourhood. However, the Museumpark is now transforming into a modern, green and more pleasant part of Rotterdam where people can walk, cycle or exercise. The new deck in front of the Depot could also function as a place for festivals (Vergroening Omgeving Museumpark, n.d.). This will make the area even more of a draw for visitors.

Housing

Furthermore, some buildings in Nieuwe Werk are being transformed. A significant part will be transformed into luxury apartment complexes. The Caland estate, for example, offers temporary luxury furnished apartments for expats (Caland Estate Rotterdam, 2023).



▶ Common travel journeys



▶ Area specific wants

▶ Conscious decisions

- I want to have the feeling that I contribute a little to a greener world.
- I want to radiate that I make sustainable and conscious choices.
- I want to radiate a certain degree of status with my mobility choices.

▶ Curious about exploring novelty

- I want to use contemporary mobility.
- I want to explore and try something new when I feel like it.
- I want new mobility to be low-threshold and easy to understand in order to try it out.

▶ Reliability, efficiency and consistency

- I want to use solid mobility I can rely on, so I can do my daily trips in a consistent way.
- I want to be able to always be punctual on schedule.
- I don't want to overpay for trips I have to make every day, then the costs add up very quickly.
- I want the travel time (for daily trips) to be as short as possible and travel in the most efficient way.

▶ Independence and freedom

- I want to feel a sense of independence.
- I want to have/maintain the freedom to base my modality choice on situation-specific factors and preferences.
- I want to be able to travel at any moment I prefer.
- I want to be able to easily reach more remote places as well.
- I want to have sufficient (public transport) options in the evening/night.

▶ Convenience

- I want to experience a sense of comfort when travelling.
- I want to feel comfort in having the option to travel privately.
- I want to walk as little as possible.

▶ Bypassing the practical effects of high-traffic intensity

- I don't want to be constrained by the high traffic intensity in and around the neighbourhood.
- I want to be able to travel faster through the centre when traffic is congested.
- I don't want to feel restricted in my mobility freedom due to high traffic intensity.
- I want the area to be less crowded to travel through without decreasing the accessibility of the area.

▶ Bypassing the safety effects of high-traffic intensity

- I want to be able to use safe and comfortable options for travelling with physical disabilities.
- I want to (physically) feel safe when travelling vulnerably through the crowded centre.
- I don't want to feel restricted in my mobility freedom due to high traffic intensity.
- I want the area to be less crowded to travel through without decreasing the accessibility of the area.

▶ Travelling as an activity

- I want to travel together with friends/family.
- I want the trip to feel like an activity.
- I want to be able to see something of the city while travelling.

▶ Area related themes

▶ Habitual mobility patterns

People are ignorant of existing mobility options. Therefore, shared mobility is often only used when their first choice is unavailable, and functions more as an exceptional means of transport. People have the feeling that their habitual choice is more reliable. The car is for quite some people (residents/work commuters) still a comfortable and reliable option, despite the congested city centre, thereby only contributing to that.

▶ Freedom to choose options that reflect lifestyle

People have the (financial) freedom to make choices between multiple mobility options. This results in that people might have more room to consider other aspects (wants) besides their basic needs when choosing modalities. Examples in Dijkzigt/Nieuwe Werk include mobility which involves some sort of status or extra comfort. People are also opting a lot for more innovative mobility and try to make conscious choices regarding the environment and their own health. The question is whether this is out of personal motivation or to go along with trends and explicitly radiate this to others.

▶ Time-dependent traveller

For a lot of travellers in Dijkzigt/Nieuwe Werk, time can be seen as one of the most important factors when going from A to B. This is especially the case for people travelling to work, Hogeschool Rotterdam, or an appointment in the EMC. This is about both the shortest possible travel time (especially if someone makes this journey daily), and the importance of getting somewhere on time. Thereby, the advantage of having a private car is often mentioned as being flexible and being able to go whenever the need arises. Therefore efficiency, reliability, and flexibility are important factors.

▶ Time-independent traveller

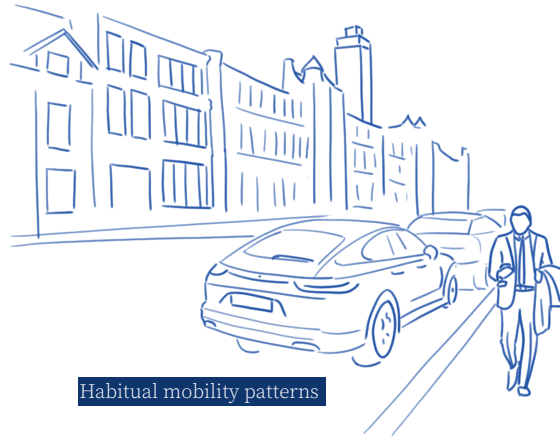
On the other hand, there is also a group of travellers for whom time is not a crucial factor. This involves travellers visiting Dijkzigt/Nieuwe Werk as a leisure activity. In this case, factors such as travelling together are of greater significance. The journey to a certain location can often also be seen as a stand-alone activity as well. For example, some people like seeing something of Rotterdam while they are travelling.

▶ Restricting freedom

Despite the area being relatively well provided in terms of mobility options, people feel that their freedom is sometimes limited. This has various causes. For example, public transport is limited in the evening and night. Many people are also worried about the plans of scrapping tram 7. On the other hand, there is also the feeling of freedom restriction due to physical limitations, something that is especially relevant for trips to the hospital. The feeling of insecurity due to the traffic intensity is a reason people become anxious about cycling, and will therefore choose another mode of transport.

▶ Pleasant and wealthy atmosphere

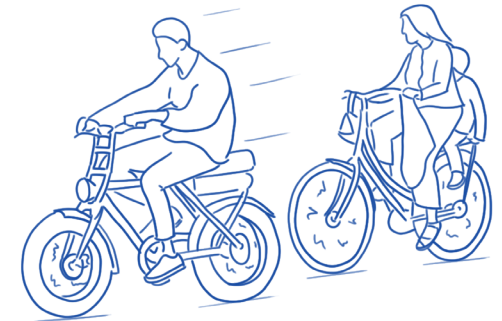
Dijkzigt/Nieuwe Werk is a high-class but diverse area. Nieuwe Werk is mainly characterised by large stately and monumental buildings, which now mainly function as offices for law firms and real estate. On the other hand, there is a strong contrast with the rest of the area, where more modern high-rise buildings can be found. Combined with architectonic highlights (such as Depot Boijmans Van Beuningen) and plenty of greenery, this forms a visually appealing neighbourhood that exudes prosperity. This prosperity can also be seen in the cars on the streets and the restaurants and shops in the area.



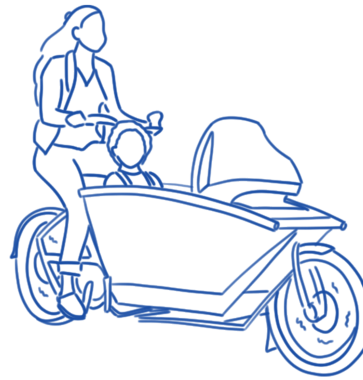
Habitual mobility patterns



Pleasant and wealthy atmosphere

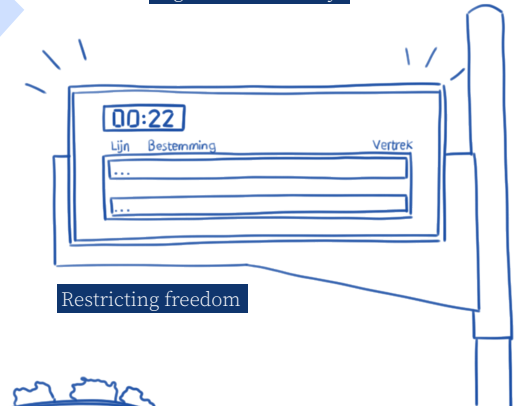


High traffic intensity

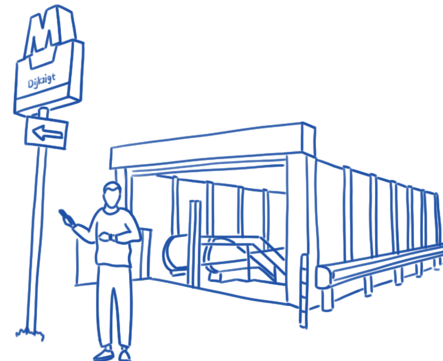


Freedom to choose options that reflect lifestyle

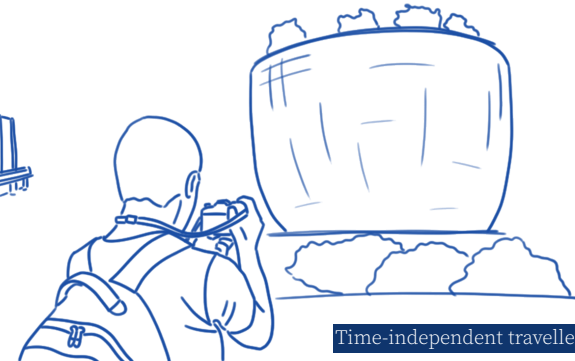
Dijkzigt/
Nieuwe Werk



Restricting freedom



Time-dependent traveller



Time-independent traveller

► Impression of Dijkzicht/Nieuwe Werk



Veerhaven



Museumpark



Hogeschool



Stately buildings



Restaurants



Het Park



Erasmus Medical Center

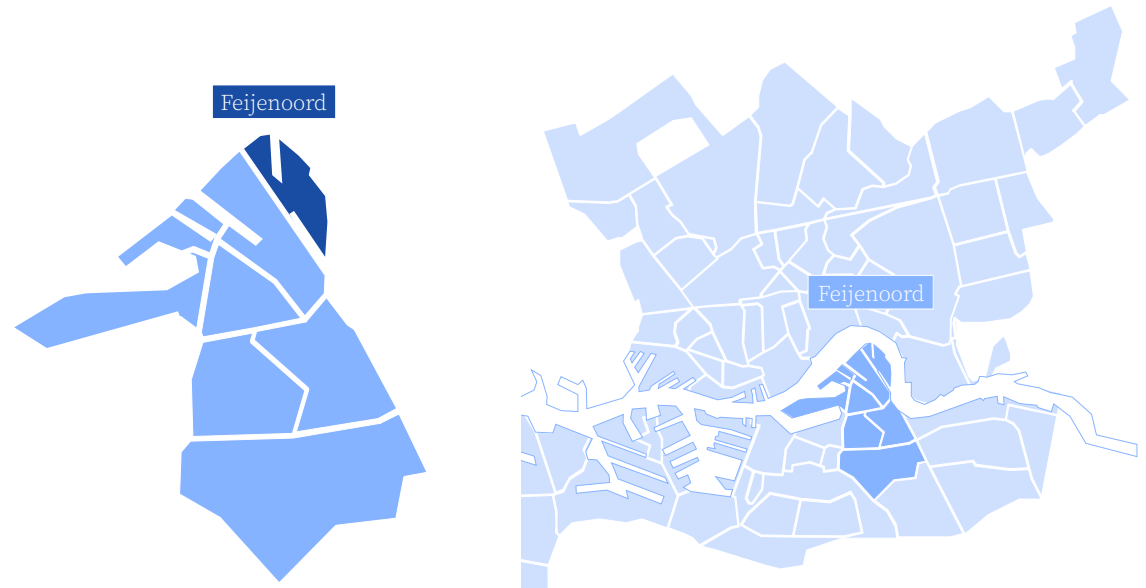


Apartment Complex

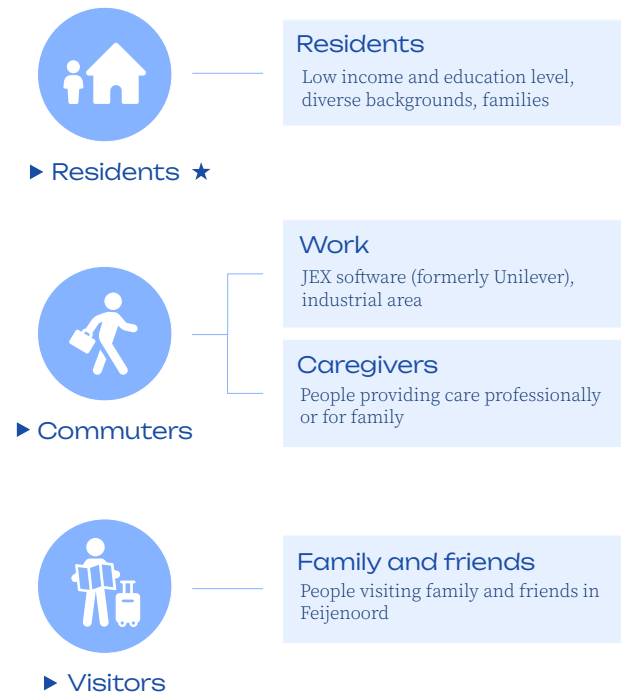
Feijenoord

Area profile

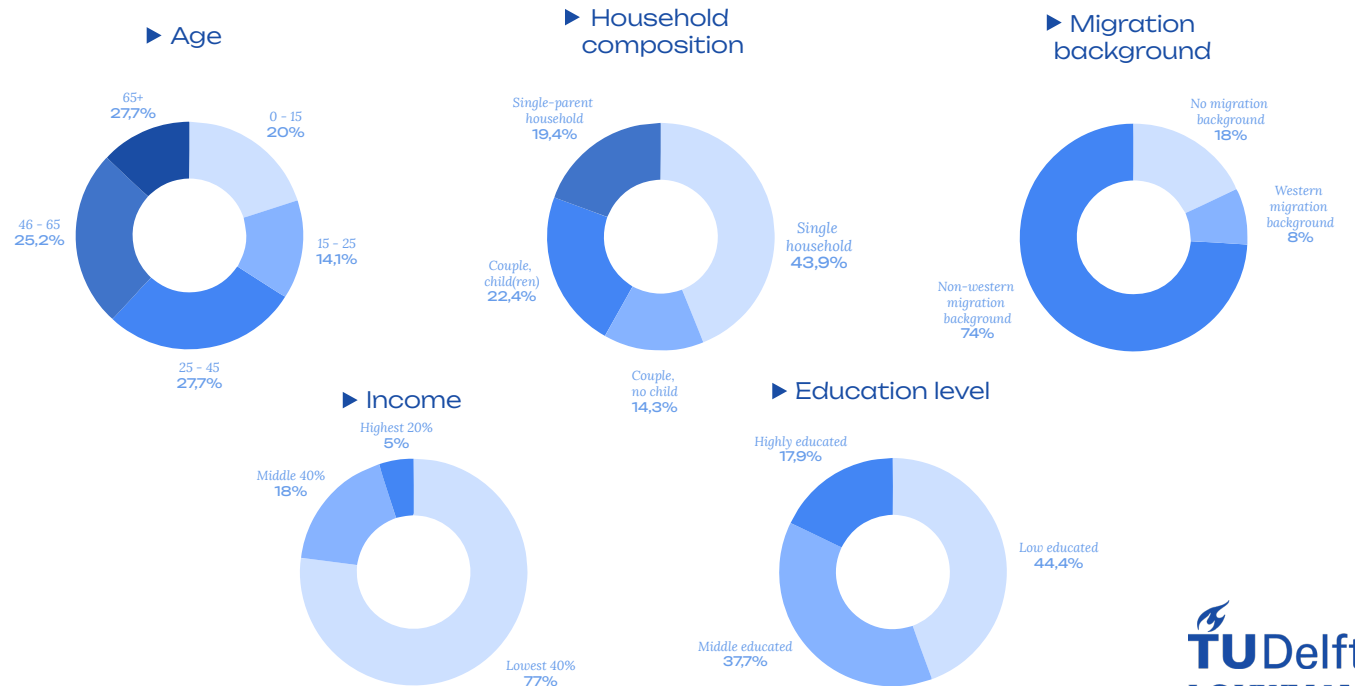
Feijenoord has over 7500 residents, with 82% having a migration background. Both educational and income levels in the area lag behind the Rotterdam average. Simultaneously, in recent years, the neighbourhood has attracted a significant number of new residents with higher educational and income levels, particularly in the vicinity of the Feijenoordkade (Gemeente Rotterdam, 2022b). In Feijenoord, there are numerous social facilities for the residents of the area, such as 'Huis van de Wijk De Dam' and 'Sociaal Café onder de Oranjeboom'. Here they offer special programs for residents (and made by residents), where people are encouraged to actively participate in society.



► Overview relevant travellers



► Demographic information residents



▶ Development degree

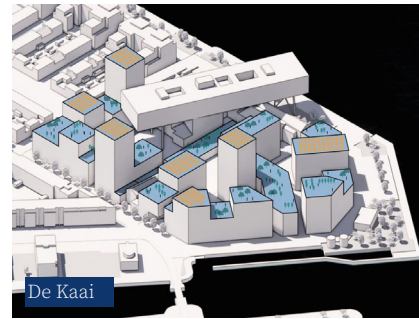


Housing

In Feijenoord, there are numerous housing plans underway. In the northern part of Feijenoord, the Hefkwartier is under construction. These are residential properties in the high and top segments (Wonen in Rotterdam, 2023). Many of these homes are already inhabited, and the contrast with the rest of Feijenoord is clearly visible. In addition to the Hefkwartier, there are many other plans for the neighbourhood, such as De Kaai. Gemeente Rotterdam highlights that it's important that the northern part of Feijenoord does not transform into a 'golden edge', but rather that there should be a focus on integrating with the existing neighbourhood and original residents (Gemeente Rotterdam, n.d.). Additionally, a huge number of new homes will be constructed in the neighbouring Feyenoord City, which will certainly also impact Feijenoord.

New city bridge

A new riverside connection will be established between Kralingen/De Esch and Feijenoord/IJsselmonde. The bridge is closely linked to plans to construct tens of thousands of homes in the area running from Prins Alexander to Zuidplein over the coming decades. A fast tram connection will run across the bridge, linking the public transport hubs Zuidplein and Kralingse Zoom. Besides that, the bridge is primarily intended for cyclists and pedestrians, allowing only limited automobile traffic. It is anticipated that the bridge will be completed around the beginning of 2033 (NOS, 2023). This new riverside connection will reduce the isolation of Feijenoord (and the rest of Rotterdam Zuid), making it a more attractive place to live and work. However, it may also lead to disruptions for residents living around the bridge.



▶ Area specific wants

▶ Low-threshold innovation development

- I want to use something that feels familiar, confidential, close to traditional, and close to current habits.
- I want change to happen slowly (introduction of new mobility systems).
- I want the mobility offered to be clear, comprehensible, and consistent.

▶ Community connection

- I want to be able to help people when needed.
- I want to have the option to travel together (take someone somewhere).
- I want to have a feeling of connection with others.

▶ Overcome personal barriers to mobility freedom

- I want to feel a sense of mobility freedom despite...
 - not holding a driving license.
 - not speaking Dutch (or English).
 - not having the skill to ride a bicycle.
 - having a low disposable income.
 - my physical disabilities.
 - having more cognitive challenges (illiteracy, low education level).
 - the fact that the area where I live is isolated (both in terms of the offer and geographical location).
- I want sometimes to be pushed to move towards more mobility freedom.
- I want the mobility offered to be clear, comprehensible, and consistent.
- I want to be able to bring stuff/luggage while travelling.

▶ Overcome external barriers to mobility freedom

- I want it to be more low-threshold to go out of my neighbourhood for certain activities.
- I want to have transfer-free journeys as well.
- I don't want to be dependent on the inadequate public transport network.
- I want to have more mobility opportunities and be able to make more choices.
- I want to have the feeling that more special facilities are easily reachable besides the basic facilities nearby.
- I want to experience more social safety while travelling.
- I want to feel safe while travelling regardless of the anti-social driving behaviour of others.

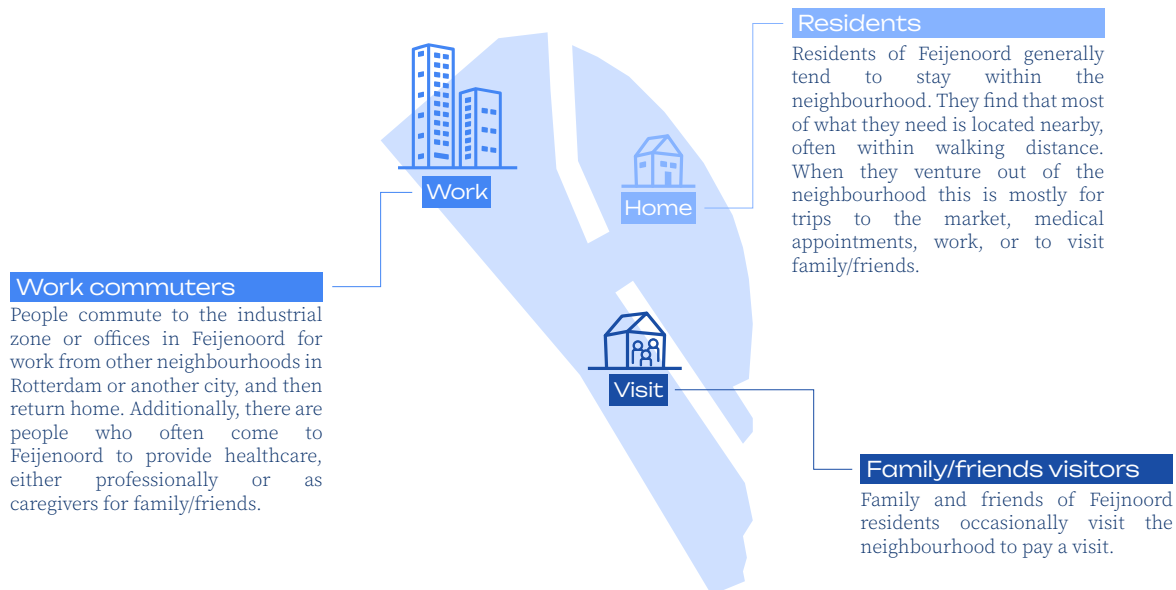
▶ The feeling of integration

- I want to have the feeling that the municipality/policy makers are thinking of us in development plans.
- I want mobility solutions that can be used for both the original residents and the new residents.
- I don't want to feel chased away by new residents.
- I don't want mobility to become even more expensive and/or complex.
- I don't want developments in the area to have a negative impact on the traffic intensity (and parking pressure).

▶ Neighbourhood accessibility

- I want mobility and infrastructure to go well together (bumps in the road and narrow bicycle lanes make it difficult for mobility scooters).
- I want the car to have a less dominant role in the neighbourhood.
- I want the area to be more attractive and accessible for micromobility (cycling, walking, mobility scooters, etc.)
- I don't want to have to depend on being able to park mobility on private property.

▶ Common travel journeys



► Area related themes

► Trustful and social to the known (inner circle)

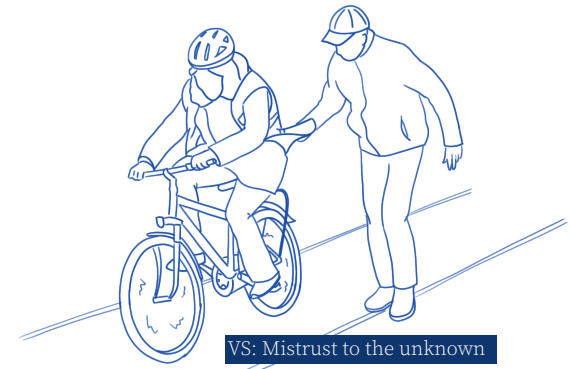
In Feijenoord, the bond with family and friends is strongly evident. Being together with family is a significant central aspect of the neighbourhood, intertwined with many daily activities. Additionally, people are willing to help each other, even when facing challenges themselves. Numerous social initiatives can be found in the neighbourhood where residents support each other. The area mainly features residents, giving it a sense of a close community.



Trustful and social to the known (inner circle)

► Mistrust to the unknown

While people are very social within their own circles, they are more distrustful towards the unfamiliar. This is noticeable in various aspects. People tend to be relatively reserved when it comes to sharing information, particularly demographic data. Additionally, it can be challenging to approach strangers and strike up a conversation on the street. However, when engaging in social circles, such as at 'Sociaal Café Onder de Oranjeboom', everyone is quite open to conversation. Furthermore, there is a general apprehension towards trying new things. Learning to ride a bike, for example, is often a significant obstacle. Additionally, residents complain about how policymakers handle things, which may result in feeling neglected or overlooked.



VS: Mistrust to the unknown

► Potential segregation between the original residents and new yuppies

In the northern part of Feijenoord, a large new residential area is under construction, targeting a contrasting group of people compared to the original Feijenoord residents. Additionally, there are other new construction plans in the pipeline. It is already evident that a strong contrast exists between these areas, and this will only intensify as the plans progress further. Gemeente Rotterdam also points out that it's crucial to look at how the new residents could integrate with the original inhabitants and to listen to the values of both groups.



Work with what you have/make-do-attitude

Feijenoord



'Basic'/compact' lifestyle

► Personal limitations for mobility freedom

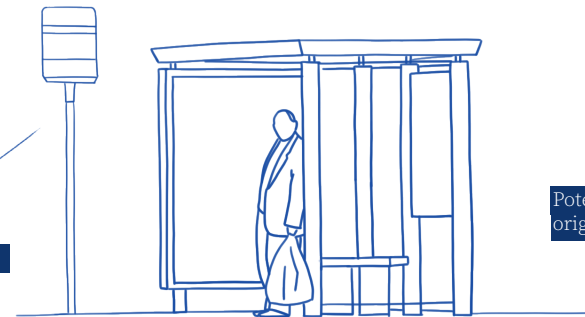
Overall, many people experience personal limitations regarding mobility freedom. This is mostly related to a low disposable income, physical limitations, cognitive challenges (such as low education, digital illiteracy, or not speaking the language), and/or the absence of certain skills (such as cycling or holding a driver's license). This may also be influenced by cultural differences, home situations, and other external factors. Particularly, the elderly are often nostalgic about the past when they had more opportunities and mobility freedom. The desire for mobility freedom is significant, even if not everyone may be consciously aware of it (yet).



Personal limitations for mobility freedom

► External limitations for mobility freedom

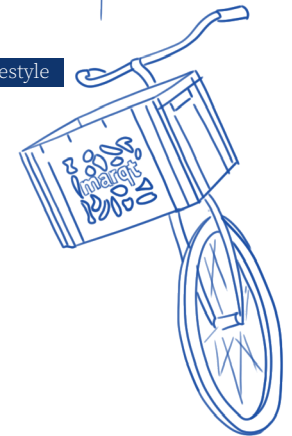
In addition to personal limitations, external factors also play a role in limited mobility freedom. Feijenoord is highly isolated both geographically (related to the presence of the Maas) and in terms of mobility options. There are very few public transport options available, resulting in long journeys that require multiple transfers.



External limitations for mobility freedom

► 'Basic'/'compact' lifestyle

People in Feijenoord lead relatively straightforward lives, with most of their daily activities taking place within the neighbourhood. Many facilities are within walking distance. However, this is largely the effect of aspects of mobility poverty. People have limited opportunities (due to external and/or personal limitations) resulting in a sense of isolation within their own neighbourhood.



Potential segregation between the original residents and new yuppies

► Work with what you have/make-do-attitude

Despite facing many challenges, the people in Feijenoord maintain a positive outlook and focus on finding solutions. Given the limited opportunities, they make do with what they have. If it's raining, they simply put on a raincoat instead of complaining, and carry bags in creative ways. Additionally, many see walking and cycling as their daily dose of exercise. However, it's important to note that this is often the only option available, so such statements could also serve as a way to conceal the lack of other alternatives.

► Impression of Feijenoord

Social initiatives



Rundown and grey area



Industrial zone



Cultural and local facilities



Hints of gentrification



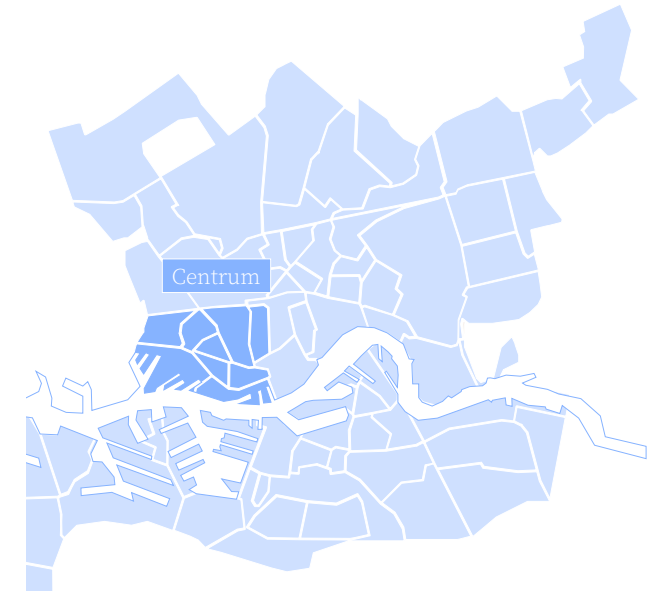
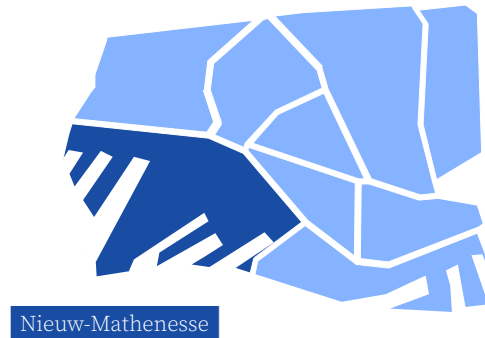
Special mobility



M4H

Area profile

Gemeente Rotterdam and Havenbedrijf Rotterdam want to develop Nieuw Mathenesse/Merwe-Vierhaven (M4H) into a sustainable and car-free living and working environment, optimally equipped for the innovative manufacturing industry with a mix of working, living, culture, leisure, and education (Over M4H Rotterdam - M4H Rotterdam, 2020). M4H will accommodate various residential environments. These environments will differ in terms of density, housing typology, target group, function mix, and price segments, yet all carry the history of the port (Gemeente Rotterdam, 2023).



► Overview relevant travellers



► Residents ★

Residents

Mixture of different incomes and ages, mostly small size households, ideally open for an innovative lifestyle



► Commuters ★

Work

Creative and innovative manufacturing industry with a focus on prototyping.

Logistics

Significant level of supply is needed for the manufacturing industry.



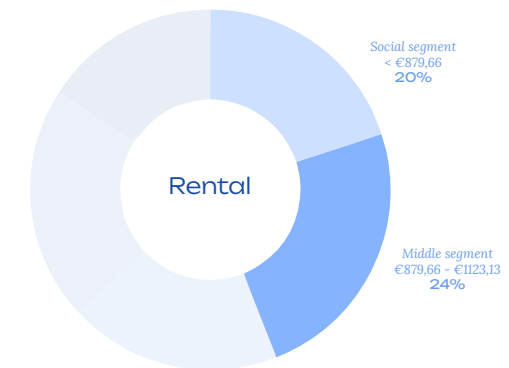
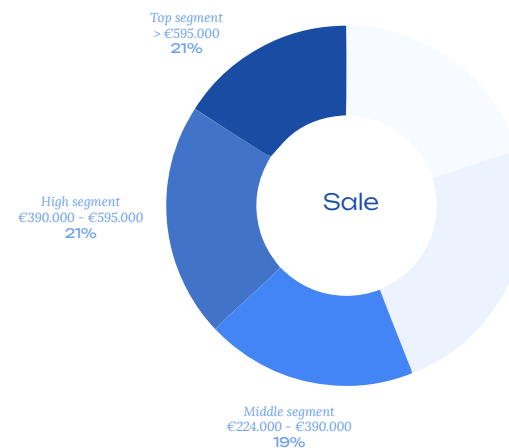
► Visitors

Visitors

Visitors for public functions in M4H and residents from surrounding neighbourhoods using facilities in M4H.

► Demographic information residents

► Housing



► Target groups

- Single household
- Back into the city, 55+
- First-time buyer in the housing market
- Empty nesters
- Couple without children
- Small family
- Elderly

▶ Development degree

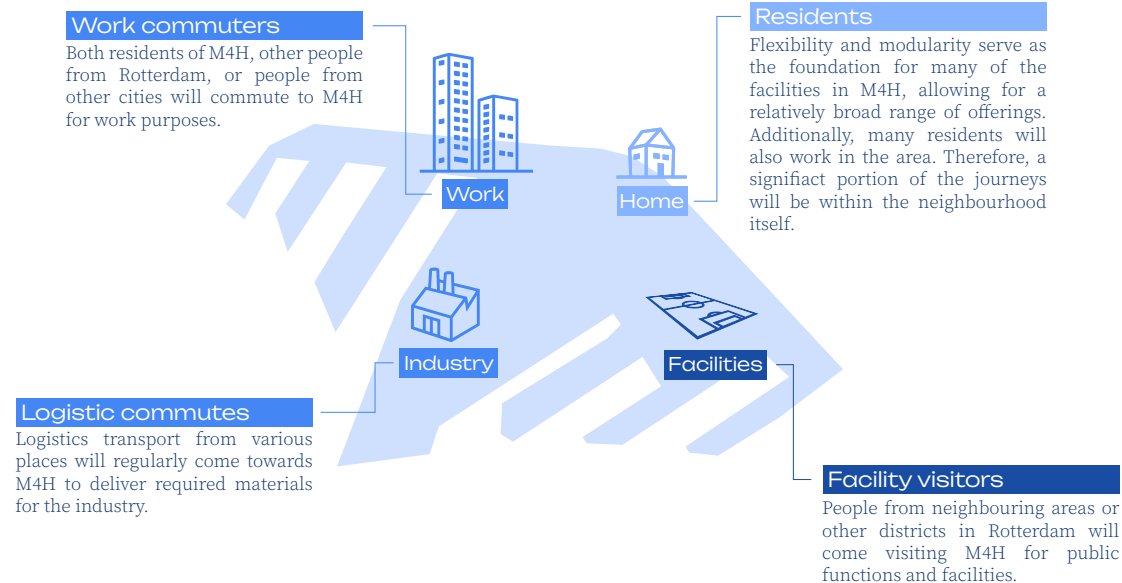


Once one of the largest fruit ports in the world, M4H is now primarily known for the numerous creative and innovative manufacturing companies based in the old warehouses and hangars. With the gradual decline of port activities, the area will evolve into a new living and working district in the coming years (Wonen in Rotterdam, 2023b).

It will be a prolonged process of development. There is now a fairly concrete vision for 2035, and subsequent plans and ideas for 2050. The Merwehaven area in M4H will be the first to undergo transformation, with other areas to follow. As the area remains in transformation for an extended period, social safety will be under pressure in the (currently rough) area, making cyclists and pedestrians vulnerable.

In terms of mobility, the focus will primarily be on alternative forms of mobility rather than cars, with a strong emphasis on sharing. Innovative and sustainable forms of mobility will be tested and implemented in the area, functioning as a testing ground and showcase of the circular urban future (Gemeente Rotterdam & Havenbedrijf Rotterdam, 2022). Moving to a new neighbourhood is often an opportunity to reconsider mobility habits and restart lifestyles.

▶ Common travel journeys



▶ Area specific wants

▶ Interest in innovation

- I want to explore innovative and/or experimental lifestyles.
- I want to be surrounded by things that inspire me.
- I want to feel that I belong to a group that has an innovative and future-proof outlook.
- I want to experience a sense of flexibility in the function of elements.
- I want to contribute to an innovative environment by sharing and collaborating.
- I want to explore new types of mobility.
- I want to actively use clean and active forms of mobility.
- I want to tackle things in a playful way.

▶ Sharing and collaborating

- I want to contribute to an innovative environment by sharing and collaborating.
- I want to commit to take the neighbourhood to the next level.
- I want to feel a sense of collectivity with others

▶ Sense of community and social engagement

- I want to feel a sense of collectivity with others.
- I want to feel engaged in my neighbourhood.
- I want to feel socially connected to the people in the neighbourhood.
- I want certain facilities to encourage social bonding.
- I want to be surrounded with a diverse group of people.
- I want to commit to take the neighbourhood to the next level.
- I want to be surrounded by a spontaneous, lively, and friendly environment.

▶ Dealing with shortcomings in a car-free area

- I want the area to be easily accessible despite being car-free.
- I want to have the opportunity to be able to always be punctual on schedule.
- I want to feel that I don't miss the car in a car-free area, also as little as possible in exceptional cases.
- I want the area to be easily accessible for visitors who are not used to the system.
- I don't want to be negatively affected by the inaccessibility of the area (difficulties in delivering parcels).
- I want to have enough facilities closeby if I live in a car-free neighbourhood.
- I don't want the area to turn into having a commercial character.

▶ Integration of vulnerable people

- I don't want to feel limited (in the mobility system) due to personal restrictions (such as income, physical limitations, or skills).
- I don't want to be forgotten in development plans.
- I want to have the freedom to choose mobility options based on situation specific wants.

▶ Respond to area developments

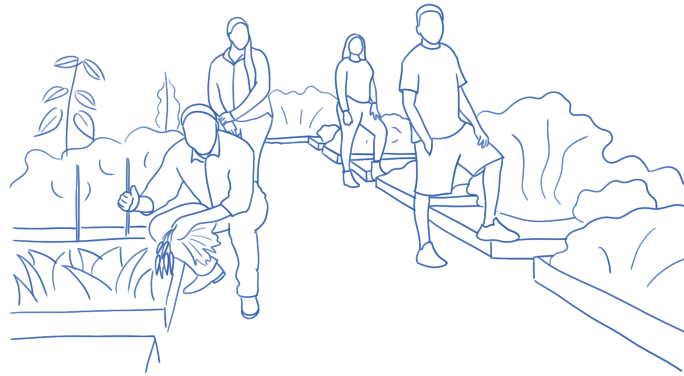
- I want the mobility offer/system to grow with my preferences.
- I want to feel socially safe in an area still undergoing long-term transformation from an industrial zone (especially at night and especially relevant for vulnerable travellers such as cyclists and pedestrians)
- I don't want to be forgotten in development plans



► Area related themes

► How to not miss the car in a car-free area?

In a car-free area, several considerations arise, with accessibility being a central point. Accessibility is crucial for the industry in the area, for their own employees, visiting clients, as well as logistical supply needs. However, accessibility is also relevant for residents. What happens in exceptional situations, such as during a move, or when someone needs to be taken to the hospital? And how does this affect a delivery driver who can no longer park directly in front of the door?



Combining, mixing, collaborating, sharing

► Facility sufficiency in a car free area

Regarding facilities, people expect there to be a sufficient and varied offering nearby that can be reached within walking distance. The more car-free the neighbourhood becomes, the more facilities it requires. On the other hand, the municipality prefers that people go to the city centre for more commercial facilities. M4H should also not become too commercial in character. According to the plans, there will be no retail stores where sales are the primary activity (aside from shops for basic necessities).



Facility sufficiency in a car free area

► Doubting the social safety of the area

As the area will remain in transformation for a prolonged period while people already live and use the neighbourhood, social safety in the rough parts of the neighbourhood will be a significant concern. Cyclists and pedestrians are particularly vulnerable, especially in the evenings and at night. During this development phase, a strong contrast and contradiction will be noticeable between the vibrant and friendly atmosphere that is being actively sought to be created.



Doubting the social safety of the area

► Combining, mixing, collaborating, sharing

Stimulating collectives is a key focus in M4H, both for businesses and residents. From a sustainability perspective, the emphasis is on the sharing economy through shared transportation and collective energy generation for example. There is a strong emphasis on meeting and collectivity, with public spaces and facilities being well-suited for this purpose. Additionally, many functionalities will be flexibly combined. Mobility hubs are examples of this. In addition to mobility offering, they can also function as meeting places, social workspaces, parcel points, and meeting rooms. If functions can be stacked or combined, this is aimed to be utilized.

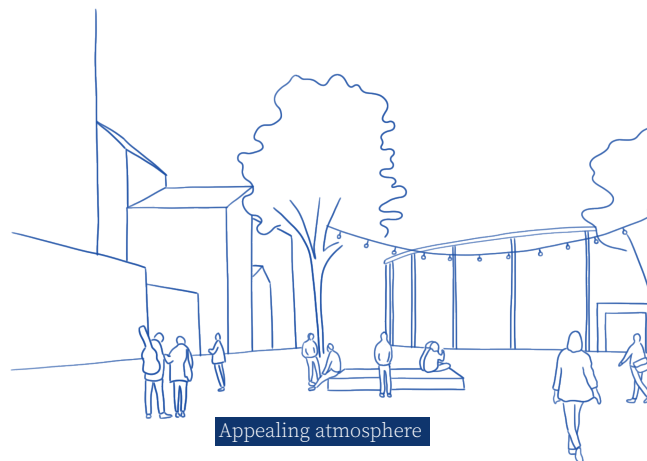
Nieuw Mathenesse



How to not miss the car in a car-free area?

► Appealing atmosphere

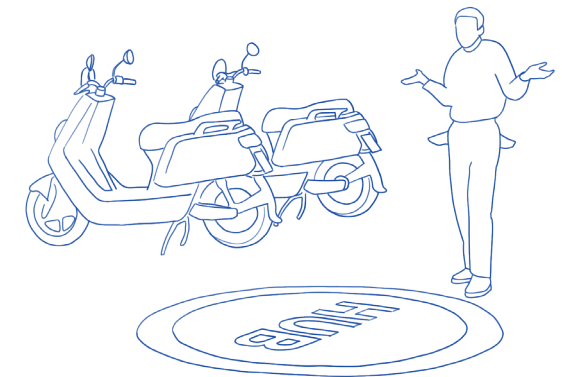
The intended atmosphere in M4H aims to create an appealing environment for people who are open to new experiences, enjoy a vibrant living environment, and willingly utilize collective facilities. The combination of the history of a characteristic port area, creativity, and modern architecture makes it an attractive area for many. The aim is to foster a pleasant, friendly, and lively atmosphere with plenty of room for spontaneity. At times, the descriptions may sound almost utopian.



Appealing atmosphere

► Doubting inclusiveness: Innovative character vs personal limits of vulnerable groups

However, the plan still has its challenges, and it may indeed be overly idealistic. Inclusivity in the neighbourhood poses a significant challenge. While the intended community primarily attracts those who embrace innovation and are open to such concepts, there is a requirement from the municipality that 20% of the housing in the neighbourhood must be designated for social housing. These people may not necessarily have different needs and wants, but may face more personal limitations to contend with (such as lower income, physical limitations, or digital illiteracy). In urban development, it's common to aim for creating an environment where everyone could potentially live, but in practice, the design often diverges. This applies not only to people with low-income, but also to elderly and other vulnerable groups. More effort is needed to make the area appealing to every intended target group.



Doubting inclusiveness: Innovative character vs personal limits of vulnerable groups

► Impression of Nieuw Mathenesse

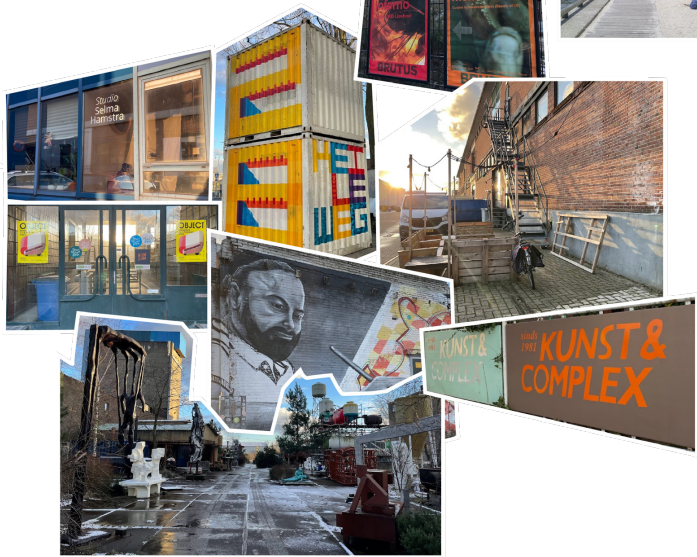


Creative and innovative industry

Creative and industrial



Community based facilities and public spaces



Special housing solutions

Innovative mobility



5.9 Conclusion and evaluation

Conclusion and follow-up steps

This chapter distilled the raw findings from Chapter 4 into a selection of relevant findings. The data analysis resulted in a set of sub-themes and main-themes for each neighbourhood. Needs and wants were then formulated on the basis of these sub-themes. A combination of previously known information and the research conducted is synthesised into the three area profiles. These area profiles serve as a guide for the next phase and can also be used as a communication tool for others to gain an understanding of the neighbourhood. The next phase will begin with the selection of one of the overarching similarities between the neighbourhoods, as outlined in this chapter. This will serve as the basis for further ideation of the concept, incorporating the area-specific wants.

Approach iterations and considerations

Analysis approach: The first attempt to analyse the data was done in a somewhat quantitative way. However, this resulted in some relevant information being overlooked. It also led to relatively superficial results. A more flexible approach, involving the researcher's own interpretation, therefore works better. However, by still approaching the process systematically, it still provides the necessary framework.

Scales: It was a bit of a trial to find the best way to set up the scales. As interests can vary widely within a neighbourhood, the positioning of sub-groups on the scales was also experimented with. However, this led to a loss of overview. In the end, a compromise was made in case there were conflicting interests.

Approach limitations

Identifying similarities: Within this approach, the emphasis was primarily on identifying differences. Identifying similarities could have been done more systematically using scales as well.

The accessibility of wants: Throughout the process, it became clear that differences in wants are often a result of the current circumstances in which people find themselves. For instance, it could be that deeply, the people in Feijenoord would have more similarities with Dijkzigt/Nieuwe Werk, but due to limitations, it might be that the want is still out of reach. Therefore other wants have higher priority at the moment. It could be the case that in the future, in the case of positive developments, the wants of Dijkzigt will also apply to Feijenoord (and that the wants in Dijkzigt are a level higher again). You could say that Dijkzigt is some steps ahead with their wants.

Identifying needs and wants: It is also sometimes difficult to pinpoint exactly what needs and wants are. What may feel like a basic need to one person may not be the same to another. Therefore, I sometimes interpreted the search for needs more broadly, focusing on similarities as a direct basis for generality. Furthermore, a similarity between neighbourhoods is not necessarily a need. For example, in each neighbourhood, there was some sort of desire of being able to travel together sometimes. However, in the concerned situations this was not always a fundamental need, but rather a nice-to-have.

Recommendations and scalability remarks

In coding all the research findings, it was found that some parts provided richer information than others. However, it also became apparent that the different types of information complemented each other well. As an example, Figure 43 gives an overview of the sub-themes in Feijenoord, with each coloured post-it representing a different research method. This shows that many sub-themes are supported by

different methods, but also that some sub-themes emerged primarily from one particular method. This highlights the importance and influence of certain methods.

During the coding process it became clear that the qualitative data was particularly interesting. For example, most of the items in the survey came from open-ended questions. It seems to be effective to first ask people to answer a multiple choice question and then ask them to elaborate on their choice in a separate question. This approach allows for both clarity and depth of answers.



Figure 43: Overview of the sub-themes of Feijenoord, the different coloured post-its show the distribution of the origin of each coded data item

Designing for inclusivity

Phase IV

6.1 Introduction

Phase III involved analysing the data collected during the in-depth research phase, to identify similarities and differences between the neighbourhoods. In Phase IV we will continue by starting to identify a focus for the approach. This focus will be based on a similarity between the neighbourhoods to address generality and thus feasibility. The differences within this similarity will then be mapped out, which characterises each neighbourhood. Through a short ideation phase, a concept will be created, which will then be developed in more detail.



Figure 44: Concept scenario sketch

6.2 Targeting inclusivity in the mobility system

In Chapter 5 we looked at mapping differences and similarities. For concept generation, the first step is to decide on the focus. This primarily concerns what an interesting similarity is between the neighbourhoods and what can serve as the basis for the aspect of generalisation within the spectrum. We then look at how this differs from neighbourhood to neighbourhood and how it can be addressed in a feasible way.

Commonality: The exclusion of vulnerable groups

From setting up scales, which were initially intended to identify differences, a similarity emerged that was also deduced from the analysis of the sub-themes. This concerns the exclusion of vulnerable groups from the mobility system in each area. This unfolds differently in each area and to varying degrees. What makes this similarity interesting is that it tends to be on the ‘need’ side of the spectrum, but is not yet fulfilled. The basic foundation of ‘needs’ for vulnerable groups are not met yet, to which ‘wants’ can be added upon. The research suggests that this is happening to some extent in each area which makes the focus relevant to focus on. In addition, during the interview with Gemeente Rotterdam, they also indicated that finding a gap in the current mobility system is the way to add value as a party to what already exists. Besides that, this focus fits the ideology of Louwman Group well; following the pledge ‘Mobility for Life’.

“ We mainly focus on the facts and figures of people who are already using the mobility system and forget to consider the data of those who do not use it, perhaps because they cannot or do not want to, lack the financial means, or lack digital skills.

- Niek Verlaan, Policy advisor for Public Health and project manager Mobility at Gemeente Utrecht (De Jong, 2022). ”

Differences: How are vulnerable groups excluded?

The exclusion of vulnerable groups unfolds differently in each area:

Dijkzigt/Nieuwe Werk: People feel unsafe in traffic, especially when cycling and walking. This is due to the (often fast and massive) type of transportation and behaviour of other road users. Think of fast e-bikes and tuned fat bikes on the cycle path. As a result, people are afraid to cycle in the crowded city centre and prefer public transport or another mode of transport that feels safer than cycling. In addition, many cycle paths in the city centre are not separated from the main road, so cyclists also feel unsafe because of cars. This affects a wide range of target groups. On the one hand, it is a feeling experienced by all cyclists, but it particularly affects elderly, children, parents cycling with children, and particularly vulnerable hospital patients in making modality decisions.

Feijenoord: People feel restricted in their mobility freedom. This is the result of both personal and external limitations. In Feijenoord, many people face various personal limitations that restrict their freedom. People generally have a low disposable income, which limits their options. It is also a neighbourhood with diverse migration backgrounds; not everyone speaks Dutch or English, or is used to the Dutch mobility system. This is also reflected in limitations in terms of necessary skills. For example, not everyone can ride a bicycle or has a driving licence. It is also noticeable that many people have to deal with physical limitations that rule out certain forms of mobility. In addition to personal limitations, there’s also a limited range of mobility options, and the neighbourhood is isolated in terms of its location. The combination of these personal and external factors results in people generally staying a lot in their own neighbourhood.

M4H: People feel excluded from innovations in mobility. In a future where shared mobility becomes the norm, it should be accessible to everyone. From the municipality’s perspective there’s a requirement that 20% of social housing must be included in M4H. In addition, senior citizens are one of the target groups in the area.

However, the innovative mobility strategy developed for a car-free neighbourhood is not yet inclusive enough. The municipality acknowledges that this is still a focus point. If shared mobility is becoming the standard option in a neighbourhood, it must be accessible to everyone, both in terms of functionality and price. The description of the neighbourhood is somewhat utopian and lacks feasibility considerations. An interesting perspective is that M4H serves as a kind of test area for innovative mobility, but eventually other areas in Rotterdam will follow. Therefore, this will also become relevant in other neighbourhoods.

Despite each area facing specific challenges regarding the exclusion of vulnerable groups in the mobility system, some aspects overlap. This is partly because it involves people with similar limitations. This adds another dimension of generality to the issue (Figure 46).

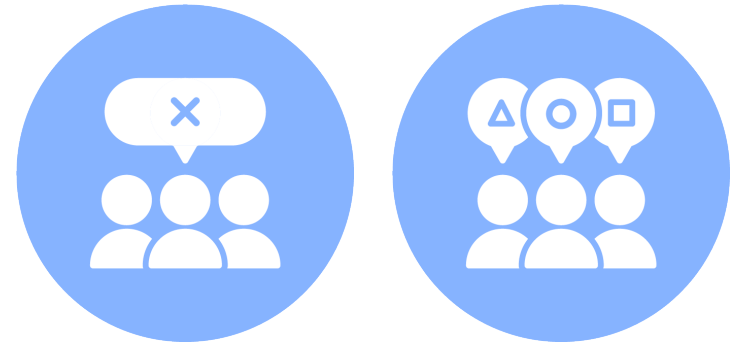


Figure 45: Commonalties and differences

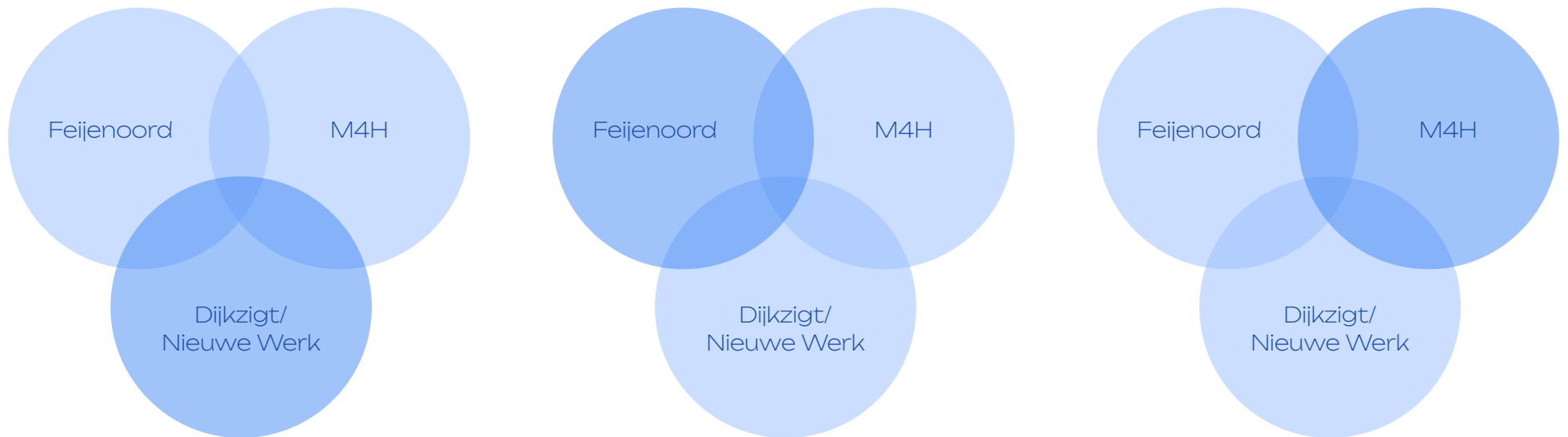


Figure 46: Within the differences, there is also a certain similarity to be found

Vulnerable groups

There are many definitions of vulnerable groups within mobility. These range from definitions related to the physical safety of road users to more social aspects.

Gemeente Rotterdam identifies vulnerable groups with regard to safety risks. This categorisation includes elderly, young people and schoolchildren as vulnerable groups. This is mainly related to their competence in traffic and the risk of accidents (Gemeente Rotterdam, n.d.-b).

The former AVV (Adviesdienst Verkeer en Vervoer, Traffic and Transport Advisory Service) used three criteria to distinguish vulnerable road users from other road users. These are also mainly related to physical safety:

- The level of external protection
- Ability to perform the task
 - Beginners (young people) or elderly
 - Disabled road users
- Resilience (SWOV, 2012).

Jankovic and Aarnink (2001) argue that every citizen should be able to go from A to B to some extent. Three groups of people may not be able to fully act to this right because they:

- Lack money
- Lack the means to transport themselves or to arrange transport
- Live in an area without public transport and do not have private transport.

Vulnerable groups in mobility can also be related to those facing mobility poverty. Jorritsma et al. (2018) propose the following definition:

“The failure or difficulty of accessing activity locations (in terms of effort expended), owing to inadequate transport options (both objective and perceived), in combination with peoples’ socio-economic and spatial conditions and personal abilities. Consequently, their participation in social life is impeded, which negatively impacts their quality of life.”

In addition, the following model of mobility poverty has been developed. It focuses on the aspects of (in)competencies, (perceived) inadequate transport options and social disadvantage (Figure 47).

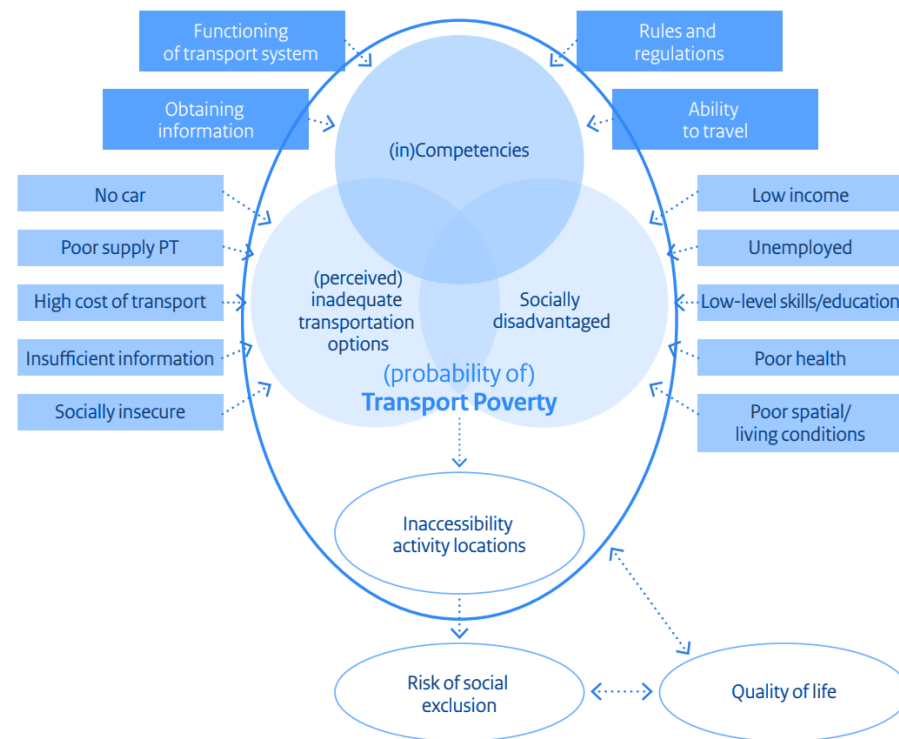


Figure 47: Model of transport poverty (Jorritsma et al., 2018)

In this project, a combination of the above elements in which vulnerability can manifest is used. These were derived from the research outcomes.

- Personal limitations
- External limitations
- Physical safety

Resulting in the following overview:

- *People with physical limitations:* People with physical limitations may require additional physical support to move around.
- *People with cognitive challenges:* People with cognitive challenges may require additional assistance in order to work with the system. Examples include being digitally illiterate, not speaking the language or having a mental disability.

- *People with low disposable income:* People with limited financial resources may struggle to afford transportation costs and therefore have limited access to mobility services.
- *People who lack the necessary skills:* People who lack necessary mobility-related skills (such as riding a bike, or holding a driver's licence) may face challenges in accessing mobility options.

However, it is important to note that this is a very diverse group of people, going well beyond the list above. This also makes it difficult to address all groups equally. Furthermore, vulnerability in mobility cannot be seen in a simplistic and binary manner, but rather as a spectrum. Between people with no limitations and those with clear and recognisable disabilities, there is a large group with more mild, sometimes invisible or temporary limitations. For example, someone who can walk but gets tired quickly, or someone who finds cycling through busy streets scary. There are no interest groups working on their behalf. They are not united and therefore not represented (Ideate & Ministerie van Infrastructuur en Waterstaat, 2023).

Problem definition

Due to a generalised approach to the mobility system in Rotterdam, vulnerable groups are left behind. In the researched neighbourhoods, it concerns:

- *Dijkzigt/Nieuwe Werk:* People feel unsafe in traffic, especially when cycling and walking. This is due to the (often fast and massive) type of transportation and behaviour of other road users.
- *Feijenoord:* People feel restricted in their mobility freedom. This is the result of both personal and external limitations.
- *M4H:* People feel excluded from innovations in mobility. In a future where shared mobility becomes the norm, it should be accessible to everyone.

Vision

A future mobility system in Rotterdam where vulnerable groups are better able to participate in mobility.

Design goal

Design a concept that addresses the issues experienced by vulnerable groups in Dijkzigt/Nieuwe Werk, Feijenoord, and M4H, in a way that is feasible for Louwman Group.

- Enhance the (perception of) physical safety for vulnerable groups.
- Increase the sense of mobility freedom for vulnerable groups.
- To integrate vulnerable groups in an innovative mobility system.

While also being relevant and applicable to the average user in Rotterdam.

6.3 Bridging ideas for multifaceted solutions

With the problem definition, vision and design goal in mind, the ideation phase began. How can we address the objectives of physical safety, mobility freedom and integration? Furthermore, are there areas of overlap between these objectives that could be the basis for a concept which is relevant to all three objectives? This was explored in a brainstorming session with fellow students, functioning as a starting point for further ideation.

Brainstorm session

To explore potential directions and ideas, a brainstorming session was organised with fellow IDE Master students. During three rounds of brainstorming, four participants worked on questions starting with “How to...”. A general question focused on how a mobility system could better meet area specific needs. In addition, for each neighbourhood-specific problem, there was a question about how the problem could be tackled. In the first round, ideas were generated around these questions in a general way. In the second round, the same questions were used, but participants were asked to come up with solutions that were as personalised as possible. In the third round, participants were asked to come up with solutions that were as generalised as possible. This resulted in twelve different sub-questions:

- *General*: How to make a mobility system more responsive to specific wants? (In a personalised/generalised way)
- *Dijkzigt/Nieuwe Werk*: How can you increase (perception of) physical safety in traffic for vulnerable groups? (In a personalised/generalised way)
- *Feijenoord*: How can you increase the feeling of mobility freedom for vulnerable groups? (In a personalised/generalised way)
- *M4H*: How can you integrate vulnerable groups within an innovative mobility strategy? (In a personalised/generalised way)

Ideation outcomes

The brainstorm was structured with the idea that breaking down the main question into smaller pieces would make it more manageable for the participants. Different ideas from the brainstorming session could then be combined to create concepts. This process resulted in nine concepts. Based on four simple criteria, the concepts were rated on whether each criteria was met, partly met, or not met:

- The solution must deliver an outcome for each area. The more value, the better.
- The solution must have a level of generality that makes it feasible.
- The solution should target as many vulnerable groups as possible.
- The solution must have potential for Louwman Group.

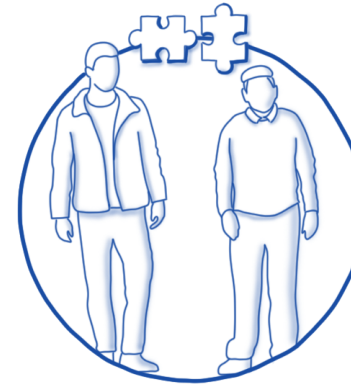
A clear winning concept emerged from this. This is explained further in the next chapter. An overview of the other concepts can be found in Appendix P, and the rating of each concept can be found in Appendix Q.



Figure 48: Brainstorm session

6.4 Concept in focus

The ideation phase ultimately brought together several ideas, each focusing on a relevant aspect, forming a concept that addresses each target point. In this chapter, this concept is further elaborated and guidelines are given on potential implementation pathways. Finally, the concept was evaluated with both the municipality of Rotterdam and Louwman Group.



Concept description

The concept is a product/service combination, centred around a stable bicycle, that addresses needs not currently met by existing offerings. The vehicle is modular, so that it can be used as an equal two seater or for cargo purposes. This vehicle will be an addition to the shared mobility offer in Rotterdam. Several (service) elements around the vehicle are essential to ensure the optimal functioning of the concept.

The bike: The bike fundamentally addresses the needs of vulnerable groups, as the current mobility system, especially shared mobility, falls short in this area. Rather than designing for non-vulnerable people and then adapting for vulnerable groups, this vehicle takes the needs of vulnerable groups and makes them also relevant to non-vulnerable groups. If you don't intentionally include vulnerable people, the risk is to unintentionally exclude vulnerable people. The vehicle provides the stability desired by older people, those with physical limitations or those who have not (yet) mastered the skills of cycling. In addition, the two seater option addresses a social aspect, approachability, and provides a low-threshold way for people to try cycling together.

Matching: In the case of a two-seater, the travel partner may be someone from the user's own circle, or it could be that the user is specifically looking for a travel partner. In this case, two travellers can be matched. This can be from a practical perspective where two people happen to be going to the same location. Alternatively, it can also be from a charitable standpoint. Helping a vulnerable person to experience more mobility freedom in this way is a relatively low threshold way of doing something good for someone. A personal profile including a rating system ensures the reliability of the matching process. This way, people can assess whether they feel comfortable with a certain travel partner.

Mobility credits: A credit system is used to make signing up as a travel partner more attractive. People are rewarded with mobility credits when they sign up as a travel partner. These credits can then be used throughout the overall mobility system, for example as free minutes for using a shared scooter.



Hub based: The concept will operate around mobility hubs for several reasons. The modular add-ons can be added or removed at the hub to configure the desired setup, making a physical hub essential. In the case of a travel partner match, a mobility hub provides a clear meeting point for the two riders. Additionally, to serve vulnerable groups, a hub-based concept allows for physical and verbal reservations, not just digital. As the hub network develops and expands, the role of the hub in this concept will grow. In the meantime, the “Huizen van de Wijk” (community centres) can play a central role. These are central community houses in each neighbourhood that are already known to many vulnerable people.



Physical and digital: As described above, it is desirable to have multiple ways of accessing the concept. This applies to the service elements such as booking a bike, the matching process and the credit system. It is desirable that those who need it can do so physically/verbally. However, this should not be the only option. In order to keep the system accessible to non-vulnerable people, a digital approach via an app is preferred.

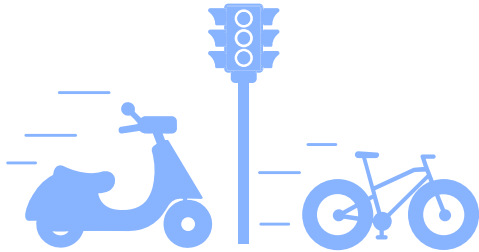


Free use/reduced price when not reserved: To accommodate people with limited disposable income, the bike can be used for free or at a reduced rate if it is not reserved. This option only applies to eligible people. An intake interview at the Huizen van de Wijk can determine eligibility for this benefit. This approach ensures that the bike can be used by those who would benefit from it and prevents it from going unused when it could be used. Additionally, this also lowers the barrier to trying out the bike.

Modularity: The bike is modular, allowing the option of cargo or child seats instead of a second passenger. In addition, a roof can be added as well. This expands its use cases and increases its relevance to non-vulnerable groups.

Target points for vulnerable groups

As described in the design goal, the concept should respond to: an enhanced perception of physical safety for vulnerable groups, an increased sense of mobility freedom for vulnerable groups, and integrating vulnerable groups in an innovative mobility system. So how does that unfold?



Physical safety

The envisioned bike provides more stability than a two-wheeler and therefore reduces the risk of falling. This makes it a safer option for those who might struggle with balancing. Also, the bike's sturdiness and wider frame offer more protection in the event of a collision, compared to a standard bicycle. Furthermore, the increased visibility of the bike makes it easier for other road users to notice, thus reducing the likelihood of accidents. By enabling two people to ride together, the bike also promotes a sense of companionship and mutual support, which can be reassuring in a busy environment. Whether riding with a friend or a matched travel partner, the presence of another person can make the experience feel safer and more secure.



Mobility freedom

Mobility freedom: One of the key aspects of this concept is its ability to serve as a low-threshold introduction to the broader mobility system. By offering the opportunity to experience shared mobility with a partner, whether someone with prior experience or someone facing similar challenges, the concept makes the transition more approachable. This collaborative approach creates an environment where people can learn from each other's experiences, share tips, and build confidence together. The combination of the physical bike element and the service elements target a variety of limitations in mobility freedom. This concerns physical challenges, cognitive challenges, low disposable income or lacking necessary skills. As people cycle themselves and are thus responsible for their own journey, they gain a sense of independence. This is crucial in fostering a feeling of mobility freedom.



Integration

Integration in an innovative mobility system: In a future where shared mobility becomes the norm, inclusivity is essential. The envisioned concept aims to ensure that vulnerable groups are not excluded from innovative mobility solutions. Also, it promotes integration by facilitating mutual learning and support. One could serve as a guide, leading the other and introducing them to the mobility system, creating a peer to peer learning approach. For vulnerable groups, who may feel uncertain about using shared mobility options, having a supportive companion can make the experience less intimidating. This approach fosters a sense of community, which aligns with the social and community based atmosphere in M4H.

Fietsmaatjes

Louwman Group is no stranger to such a concept. Through Fairshare, Louwman Group, together with customers, colleagues and partners, raised money for the organisation Fietsmaatjes over the course of a year (Figure 49). Fietsmaatjes is dedicated to mobility and freedom of movement for all, which is also a core value within Louwman Group (Louwman Group, 2024).

Stichting Fietsmaatjes rides with people who enjoy going out but are no longer able to do so on their own. These people are paired with volunteers. Together they go out on an electric duobike (Figure 50), with the emphasis on enjoyment, social contact and healthy outdoor activity (Fietsmaatjes.NL, 2023).

The intention and concept of Fietsmaatjes is quite similar to our envisioned concept. Fietsmaatjes helps many vulnerable people and is very effective in this area. However, the user context, scalability and relevance for non-vulnerable (or less vulnerable) people are elements that differentiate the two concepts.

- The envisioned concept will function on a larger scale as part of the shared mobility system within an entire city. Fietsmaatjes operates independently on a small scale and in smaller municipalities, and does not aim for large-scale implementation.
- Fietsmaatjes focuses primarily on leisure trips. The envisioned concept should also provide a solution for more practical journeys, offering the same sense of mobility freedom that non-vulnerable people are used to.
- Fietsmaatjes is only for a specific group of vulnerable people, which can give it an outdated image. In order to make the bicycle relevant to non-vulnerable people, it is important to tackle the stigma associated with it.



Figure 49: Louwman Fairshare for Stichting Fietsmaatjes (Louwman Group, 2024)



 **fiets**MAATJES.NL

Figure 50: Fietsmaatjes duobike (Rodi Den Haag, 2023)

Inclusivity and relevance for non vulnerable people

We found that in each of the three areas we studied, vulnerable groups are not optimally integrated into the mobility system. This is a significant group, especially in view of the ageing population we are facing. In 2023, the old-age dependency ratio in the Netherlands was 34%, meaning that there will be three people aged 20 to 65 for every person aged 65 or over. This ratio is expected to rise to almost 50% in the coming years, according to population projections (Centraal Bureau voor de Statistiek, 2024). However, the product must also appeal to non-vulnerable groups.

Firstly, this will blur the distinction between vulnerable and non-vulnerable groups. Whether someone is vulnerable or not is not a clear-cut issue; it's more of a spectrum. For example, someone who occasionally feels uncomfortable cycling through busy streets may not consider themselves a vulnerable person and would not want to be labelled as such. It is also important to avoid making those further down the spectrum of vulnerability feel like they are part of a restricted group. Conversely, we also want to prevent non-vulnerable groups from avoiding the concept because of the stigma associated with vulnerability. By making the concept relevant to everyone, the line between vulnerable and non-vulnerable is blurred. Marketing plays a crucial role in this process. The way in which relevance to vulnerable groups is described in this report, serves as the underlying rationale and argument for a working concept, but should not be communicated directly to potential users. Presenting the concept in a neutral way, with a wide variety of use cases, can create the desired image in the market.

However, just because a product is practically usable by everyone does not necessarily mean that everyone will want to use it. To make the concept attractive to a wide audience, it needs to be appealing in appearance and add value in terms of functionality. By incorporating different perspectives, needs and experiences into the concept, it can better meet the diverse needs and wants of users. Therefore, the bike can be used for other purposes in addition to being a two-seater. Based on the specific wants of the neighbourhoods, several ideas for modular add-ons have

been developed, allowing the bike to be used for a wider range of purposes. This is discussed in more detail in Chapter 6.8.

From Louwman Group's perspective, it is also advantageous to make the concept relevant to non-vulnerable groups. This broadens the social impact and increases its market potential. While the focus on vulnerable groups fits well with the mission of Louwman Group, it remains a commercial company. A product that can be used by all, allows new market segments to be explored and a wider customer base to be attracted, which in turn stimulates innovation and growth within the company. In addition, scalability and applicability to other cities are important factors for Louwman Group. A universal base with modular add-ons can be adapted to different locations based on area specific wants.

6.5 Pathways for concept implementation

It is now clear what the concept aims to achieve. But how can the concept be developed and what role will Louwman Group play? Given that the concept combines a vehicle with specific requirements and several service elements, it is essential to determine a logical, yet strategic approach for possible implementation. This chapter outlines two possible scenarios and provides guidance and advice for both directions.

Wholesale vs partnership

During a brainstorming session with Louwman Group's mobility innovation team and the e-commerce lead of the management team, we considered Louwman Group's role in this concept and where it would fit within the Louwman Group (Figure 51). From this we concluded that there are two possible scenarios, depending on whether a vehicle already exists that meets the requirements (Figure 52).

Scenario 1: A suitable vehicle exists

There is a product that fits the requirements well, both in terms of appearance and experience. If it is a product that is not yet available in the Netherlands, the Louwman Group could become the representative of this brand in the Netherlands. Through wholesale, Louwman Group would buy the product and then sell it internally. If Louwman Group sets up the vehicle as shared mobility, a logical step would be to market it through Cyclovriend, a subsidiary of Louwman Group. Figure 53 shows the organisational structure of Louwman Group. Additionally, Louwman could develop the associated services themselves, such as an app with a credit system, maintenance of the bicycles, battery replacements, etc. This route is more in line with Louwman Group's current practices and makes use of their existing expertise.

Scenario 2: No suitable vehicle exists

If there is no product that sufficiently meets the requirements, Louwman Group, which does not manufacture products itself, could look for a partner to develop a suitable product and deliver it as a white label solution. In this case, they would be co-investing in a new type of product, which would fall under partnerships.

However, this is something that Louwman Group has never done before and with which it has no experience. It is therefore uncertain whether this is a viable direction for Louwman Group to take.

Both scenarios will be discussed in more detail in Chapter 6.6 and Chapter 6.7. This research does not provide advice on which path Louwman Group should take. Both scenarios are explored, leaving Louwman Group to determine any possible follow up strategy.

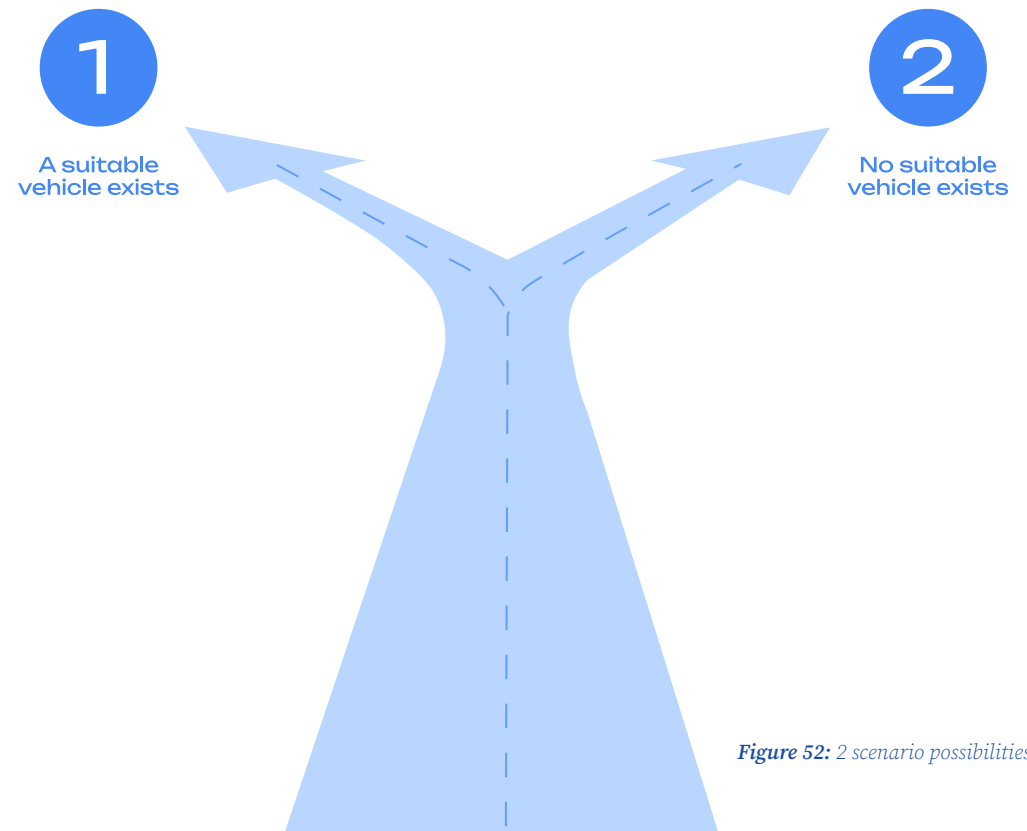


Figure 52: 2 scenario possibilities



Figure 51: Brainstorm with Louwman Group's mobility innovation team and e-commerce lead of the management team

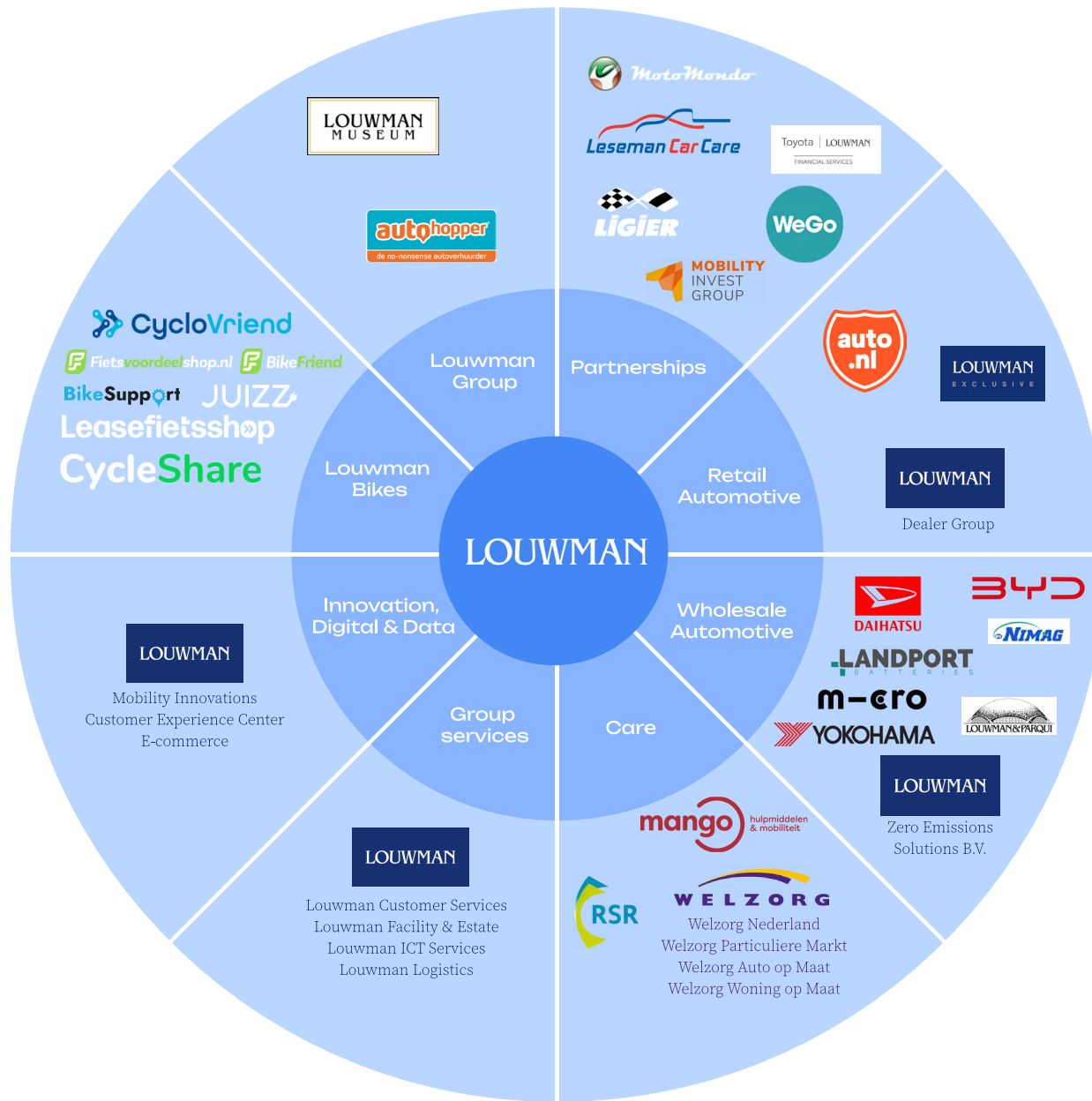


Figure 53: Louwman Group's divisions and companies

Product features

In order for the concept to have the desired impact, several characteristics have been outlined that the bike should ideally have. The concept needs to stay close to the idea of a bicycle, as bicycles provide a low-threshold and accessible way to experience mobility freedom. Moving too far away from this, for example by moving towards a small electric car, would compromise the intended effectiveness of the concept. Those product features form the base to test the relevance of existing products, related to the first scenario. In case there are no existing products meeting the requirements, the features will function as a starting guideline for a possible development as described in the second scenario.

- *Possible to travel with two persons:* The possibility to travel with two persons aims to encourage people to step out of their comfort zone and discover the freedom of mobility together. This can be with someone who is also vulnerable or with someone who is not vulnerable or more experienced. In the latter case, this also touches on the social aspect of helping people to integrate into the mobility system.
- *Provides stability:* For some vulnerable groups, stability is a key requirement. This is important for elderly who may be losing their balance, and for people who are unable or uncomfortable riding a two-wheeled bicycle. Stability also contributes to a sense of safety in busy traffic.
- *Equal seating positions:* In addition to being able to travel with two people, it is also desirable for both people to be equally positioned and to feel that they are contributing equally to the movement. It's important to give vulnerable people a sense of independence in mobility, which can be lost if they are simply being driven around by someone else. It is also desirable for both people to be able to pedal.
- *Optional co-pedalling:* Both people should be able to pedal, but this should be optional. In cases where one person is unable to pedal, there should be an option not to. Even the ability to sometimes pedal lightly can greatly enhance the feeling of independence in mobility.
- *Electric pedal assistance:* If only one person is pedalling, electric pedal assistance ensures that this remains manageable. Electric pedal assistance is also desirable for other modular configurations, such as cargo.
- *Narrow design:* To be used on cycle paths, the dimensions of the bicycle must comply with the regulations. The maximum width is 75 centimetres for a two-wheeled bicycle and 150 centimetres for a multi-wheeled bicycle (Fietzersbond, 2024). A narrower bike is preferred for manoeuvrability and to minimise inconvenience to other users of the cycle path. Use of the cycle path, instead of the main road, is central to ensuring accessibility.
- *Low entry:* For elderly and people with physical disabilities, it is essential that entry is low and easy. Getting on/in and off/out should be an easy operation. Therefore, seats that require manoeuvring into position are not desirable.
- *High seating position:* For the same people, it is important that the seating position is high enough to make it easy to get on/in and off/out.
- *Appealing design:* For the complete spectrum of vulnerable to non-vulnerable people, the bicycle should counteract the stigma often associated with special needs transport. This will make the bicycle more attractive to non-disabled groups and give vulnerable users the feeling that they are not using special needs transport.
- *Robust design:* As the bike will be used for shared transport, it is important that it is robust and huffer-proof. The vehicle should not break easily or look worn (e.g. scratches) to minimise the need for maintenance. Trade-offs around complexity in design and robustness should be made.
- *Relevance for non-vulnerable users:* Relevance to non-vulnerable groups is addressed through the look and feel, and by extending functionality through modular add-ons. The result is a vehicle that is suitable for a variety of uses and appeals to a wide audience.

6.6 Scenario 1: Exploring markt matches

Chapter 6.5 outlined two possible pathways of implementing the concept. This chapter focuses on the first scenario. The current market is analysed to see if a product already exists or is in development that meets the specified features and can achieve the desired experience within the concept. In this case, scenario 1 would be the most logical step for Louwman Group.

Vehicle exploration

For Louwman Group, the most logical way to implement the concept would be to invest in an existing product that closely matches the mentioned features. In order to explore this possibility, research was done into what already exists. This ranged from vehicles already on the market to very conceptual ideas. In addition, during the brainstorming session at Louwman Group, their expertise in this field was used by asking them to undertake the same task. This was done with the idea that they have extensive knowledge about mobility solutions that are still in development and not yet publicly known. Therefore, they were also asked to think about products that might be in the pipeline, still in the development phase, or where Louwman Group has been approached by before. During this brainstorming session, it was not necessary for all vehicles to meet all features, as a vehicle that excels in a particular feature could serve as an inspiration. Each vehicle was subsequently graded on whether each feature of the feature list was met, partly met, or not met. The grading can be found in Appendix R.

Analysis of the market

The assessment showed that no existing product met all the requirements. The main problem is that in many cases the second rider is not able to pedal. Where this is possible, the design tends to be less attractive. In terms of modularity, there is no option that allows for both two-person cycling and various modular add-ons.

Bikes that meet the functional needs of vulnerable people and provide a real cycling experience often fall short in terms of aesthetics. They tend to lean towards the stigmatised image of special needs transport, as shown in the upper left quadrant of Figure 54. These options also lack modularity features.

On the other hand, there are vehicles that have a more attractive and novel appearance but do not evoke the cycling feeling and approachability. These resemble small electric cars rather than bicycles, as shown in the lower right quadrant of Figure 54. These options also lack the two-person cycling feature, but offer more in terms of modularity options.

We are aiming for a vehicle that combines the cycling experience with an attractive and more novel appearance. However, the vehicles in this category do not meet the functional requirements, as shown in the upper right quadrant of Figure 54.

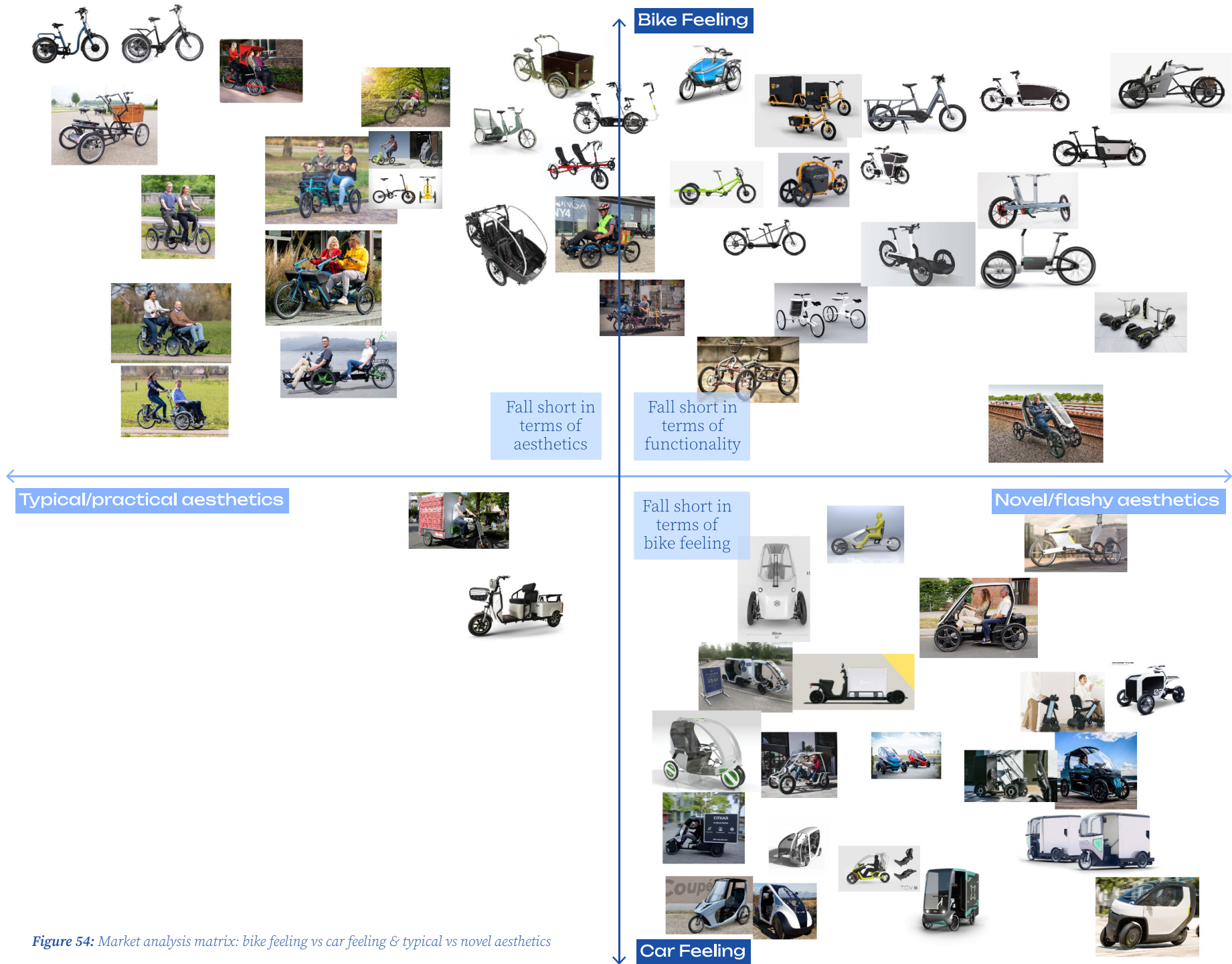


Figure 54: Market analysis matrix: bike feeling vs car feeling & typical vs novel aesthetics

Potential contenders and necessary modifications

To still be able to make a recommendation for products with potential from this selection, some vehicles are selected that might be of interest, along with the main matching features and points to consider. These could then be tested for effectiveness with a wide range of people. However, without modifications, we expect that none of these options will have the optimal desired effect.

Schaeffler Delivery

- + *Design aesthetics are considered*
- + *Modularity options*
- + *Bicycle feeling*
- *Not possible to cycle with two persons (not possible to travel with two adults at all)*
- *High entry*

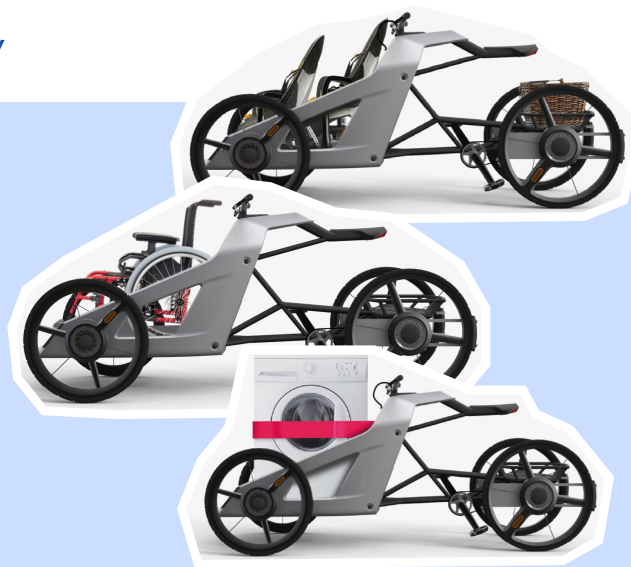


Figure 55: Schaeffler Delivery (Schaeffler et al., 2015)

Bio-Hybrid

- + *Closed and more open version which increases the bicycle feeling.*
- + *Multiple versions (cargo possibilities)*
- + *Design aesthetics are considered*
- *Not possible to cycle with two persons*
- *Open version as standard configuration is preferred*



Figure 56: Bio-Hybrid (Schaeffler, 2020)

Radkutsche Musketier

- + Diversity in modularity options
- + Bicycle feeling
- Not possible to cycle with two persons
- High entry
- Design appearance could be more interesting



Figure 57: Radkutsche Musketier (Radkutsche, n.d.)

CityQ

- + Multiple versions (cargo possibilities)
- + Design aesthetics are considered
- Not possible to cycle with two persons
- Difficult to get in the back seat
- Bicycle feeling could be stronger (standardising a roofless version and eliminating the platform)



Figure 58: CityQ (CityQ, n.d.)

Huka Copilot 3

- + Possible to cycle with two persons
- + Equal seating position
- + Bicycle feeling
- No modularity possibilities
- Stigmatised design appearance
- Not interesting for non-vulnerable people



Figure 59: Huka Copilot 3 (Huka Bikes, n.d.)

Hybrid Module Mobility

- + Diversity in modularity options
- Not possible to cycle with two persons
- Could have a stronger bike feeling (by eliminating the platform and minimising the shell)



Figure 60: Hybrid Module Mobility (Mando Corp, 2017)

6.7 Scenario 2: Defining the bicycle

In Chapter 6.6 we discussed the most logical path for Louwman Group. However, it became clear that no existing product is expected to achieve the optimal desired effect. Therefore, this chapter provides a simple and abstract study of the visualisation of a proposed vehicle by exploring seating configurations and the look and feel. It is important to note that this outline is intentionally kept very basic and serves more as an exploration to spark some imagination as to what such a vehicle could possibly look like. It should be seen as a preliminary glimpse that could serve as a starting point for further development, where more extensive research will be required.

Bicycle configurations

How the vehicle will take shape will initially depend strongly on the seating positions of the two occupants. By adding wheel positions, basic package configurations can be established.

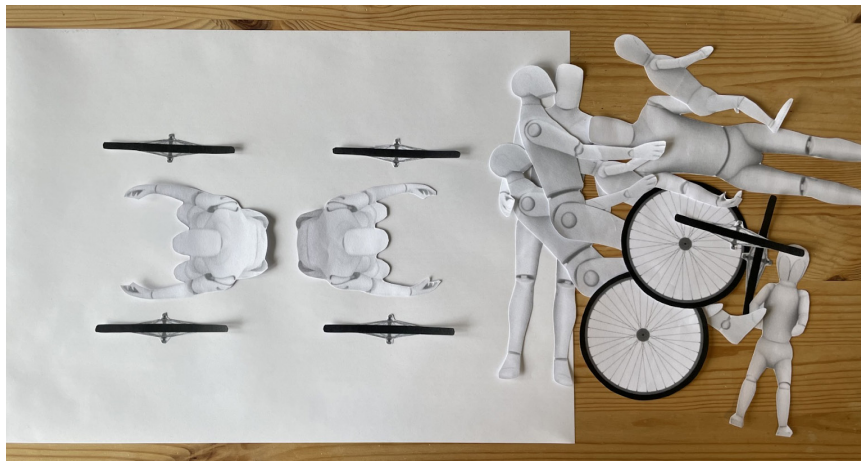


Figure 61: Exploring configurations with paper mannequins

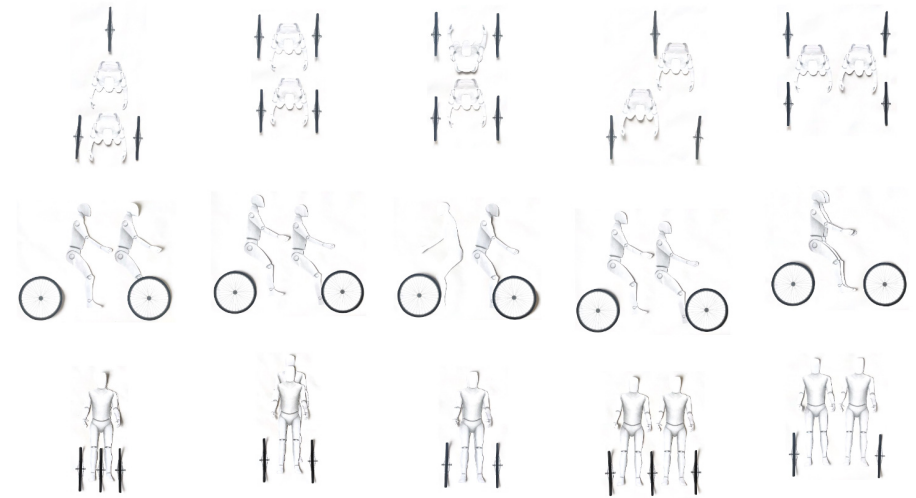


Figure 62: Trying out different seating positions and configurations with paper mannequins

By moving printed mannequins and wheels from different perspectives, it was possible to gain simple insights into the possibilities around different seating positions (Figure 61 & 62). A selection of configurations was then evaluated in terms of stability, width, equality of seating position, social interaction, visibility and modular add-on possibilities. An overview of all the configurations and their respective evaluations can be found in Appendix S.

From this study, the configuration shown in Figure 63 aligned best with the mentioned considerations. This is a stable configuration, even with only one person riding. The configuration is relatively narrow, making it suitable for cycle paths and maintaining manoeuvrability. The difference in seat height ensures that both riders have a clear view of the road. The removal of the rear seat makes room for modular add-ons. However, the configuration falls relatively short in terms of social interaction between the two people and, despite the fairly equal seating positions, there remains a distinction between the front and rear.

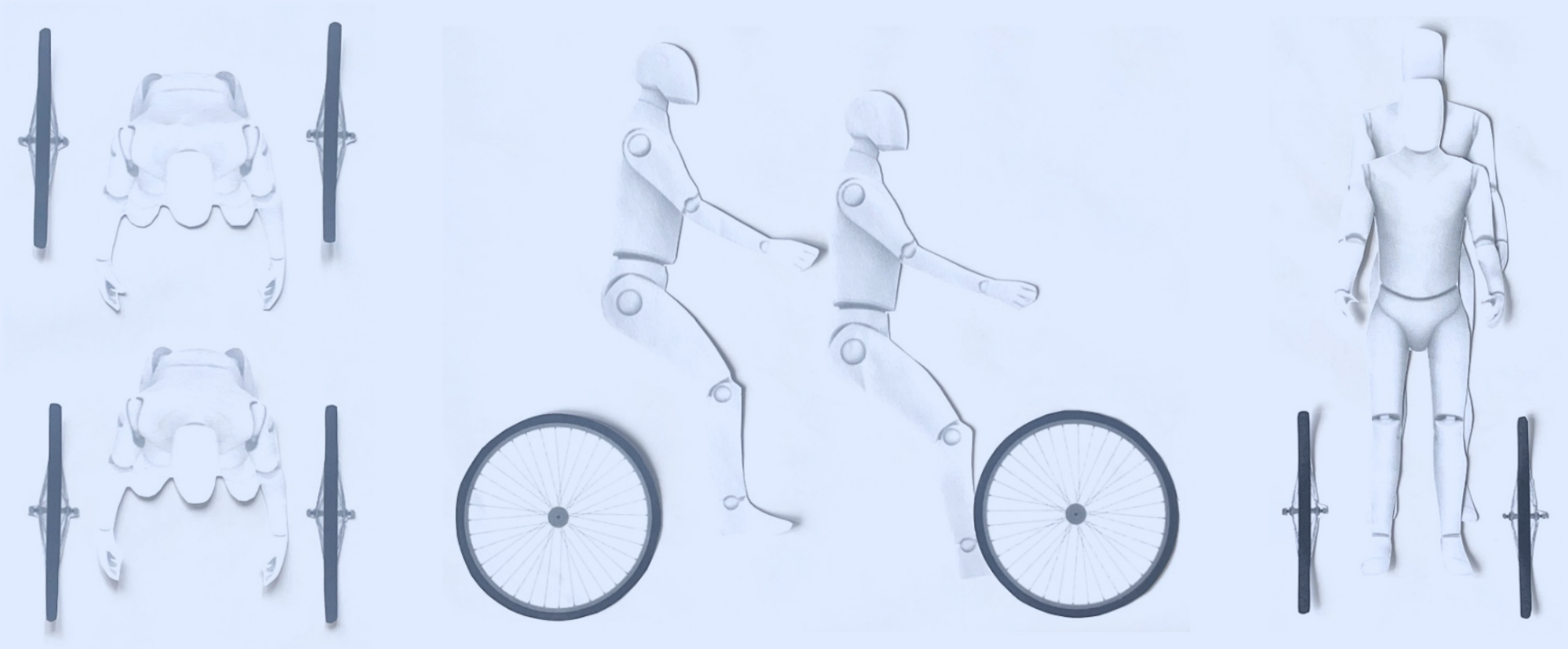


Figure 63: The configuration which aligns best with the mentioned considerations

Look and feel

The look and feel is an important aspect in making the product attractive to the wider audience and in combating the stigma associated with special needs transport. However, when considering the three neighbourhoods studied, the desired view on the look and feel varies. Through the information gathered in Phase II, each neighbourhood is represented through keywords. These keywords are derived from the visual characteristics of the environment, the functionality of the environment, the perceived atmosphere and the character of the travellers. These keywords were then visually translated into a vision for the look and feel. These three moodboards are shown in Figure 64, 65 and 66. In order to combine these three different visions into a single vision that all travellers could relate to, elements from all three neighbourhoods were combined into a representation that reflected all neighbourhoods (Figure 67). However, it is a challenge to combine three different visions into a cohesive style. Therefore, it is also interesting to consider personalisation in a dynamic way. Through digital elements and lighting, the experience can be personalised per user/neighbourhood/situation without having to be permanently embedded in the design.



Figure 65: Feijenoord

Tough, Status, Robust, Mysterious, Lavish, Practical, Traditional, Confidence, Extravagant



Figure 64: Dijkzigt / Nieuwe Werk

Contemporary, Fine, Status, Urban, Sophisticated, Chique, Trendy, Businesslike, Neutral, Minimalistic

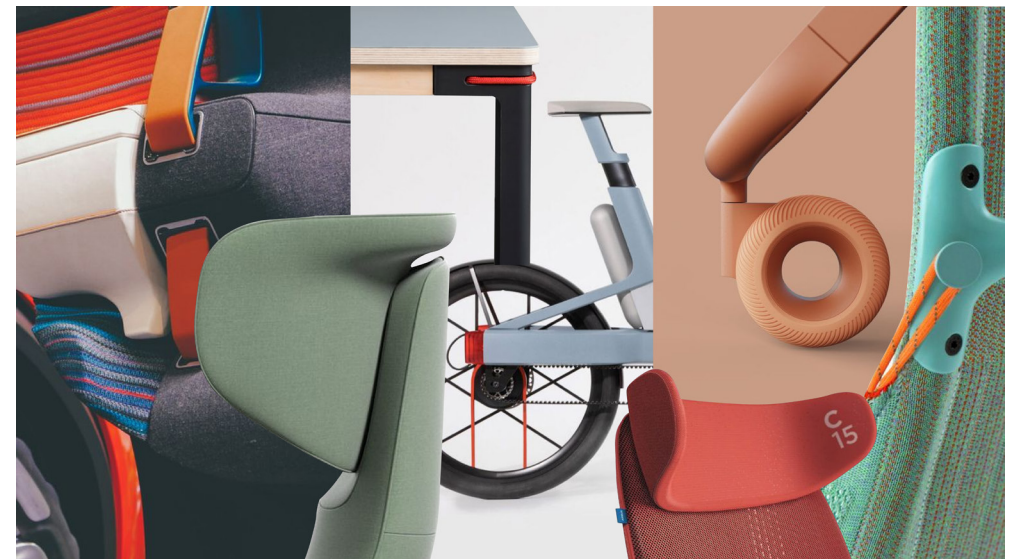


Figure 66: M4H

Bold, Playfull, Creative, Experimental, Friendly, Inspiring, Spontaneous, Lively, Open, Relaxed, Refreshing



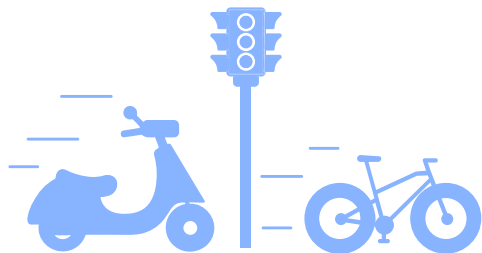
Figure 67: Combination

Lively, Confidence, Urban, Inspiring, Status, Robust, Contemporary, Open, Bold, Fine

6.8 Concept travel experience

To illustrate how the concept is experienced, three scenarios have been outlined. Each scenario addresses the focus points for vulnerable groups in the three neighbourhoods, as described in the design goal. The inspiration for these scenarios was drawn from conversations with travellers in the respective areas during the in-depth research phase, and thus comes close to reality. Looking at the theme of personalisation vs. generalisation, this chapter uses these scenarios to demonstrate how the generalised concept provides three personalised experiences, achieving what we aimed for. What was initially the question concerning this theme, is answered this way. The vehicle in these scenarios is deliberately visualised in an abstract way, more to show how the bicycle is used and experienced, rather than what it looks like. In this way, it is consistent with both implementation scenarios.

1 Dijkzicht/Nieuwe Werk Mother and child go to the museum

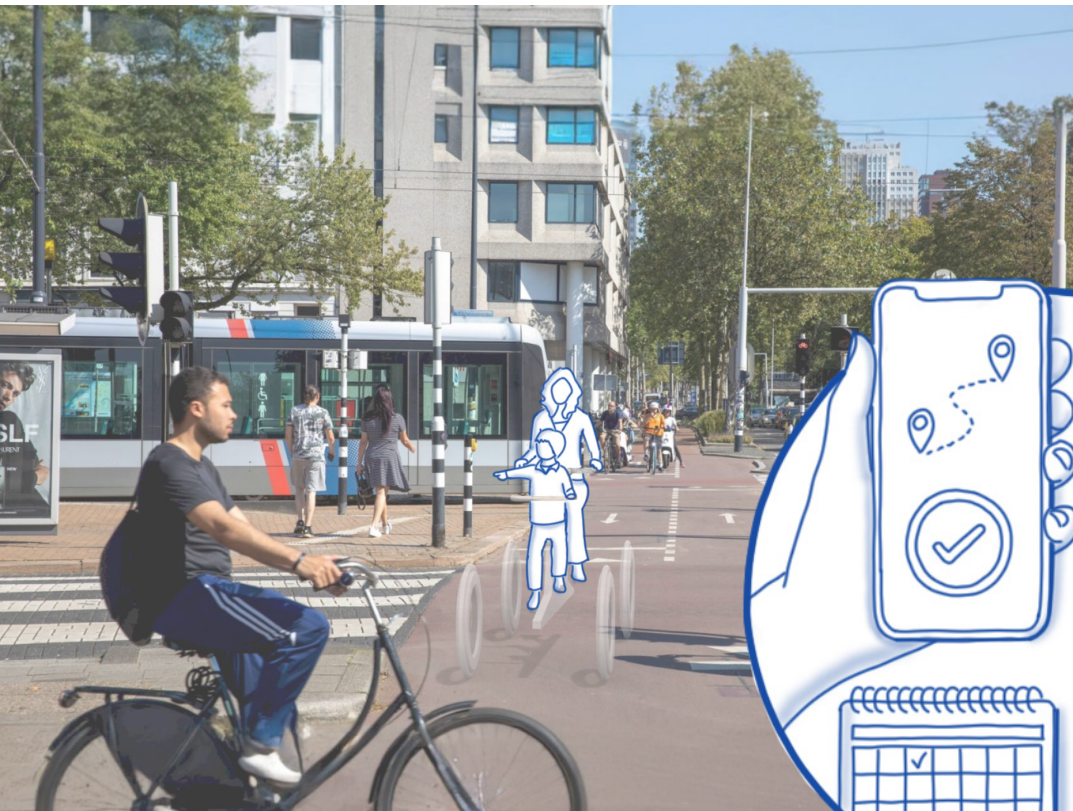


Physical safety



Figure 68: Scenario Dijkzicht/Nieuwe Werk: Physical safety

- A mother and her son have the idea of going to the Natuurhistorisch Museum in the Museumpark in Dijkzicht.
- Her son has his own bicycle, but the mother is afraid to let him ride alone through the heavy traffic in the centre of Rotterdam.
- They book a bike online and go to the hub near their home in Rotterdam Noord.



- The bike is a nice alternative to public transport which they would otherwise choose for safe travel. This way, the child still learns to participate in traffic in a safe way instead of avoiding it. The bike offers more stability and increases their visibility compared to a two-wheeler.
- They cycle together from the hub in Rotterdam Noord to the Museumpark.
- The more robust configuration of the bicycle makes them feel safer in case of an unexpected event.

- After their visit to the museum, they cycle back to the hub and walk home from there.
- For the child it was a fun experience to use such a bike, and for the mother it gave her peace of mind to go out with her child in this way.

2 Feijenoord

Two friends go to the market

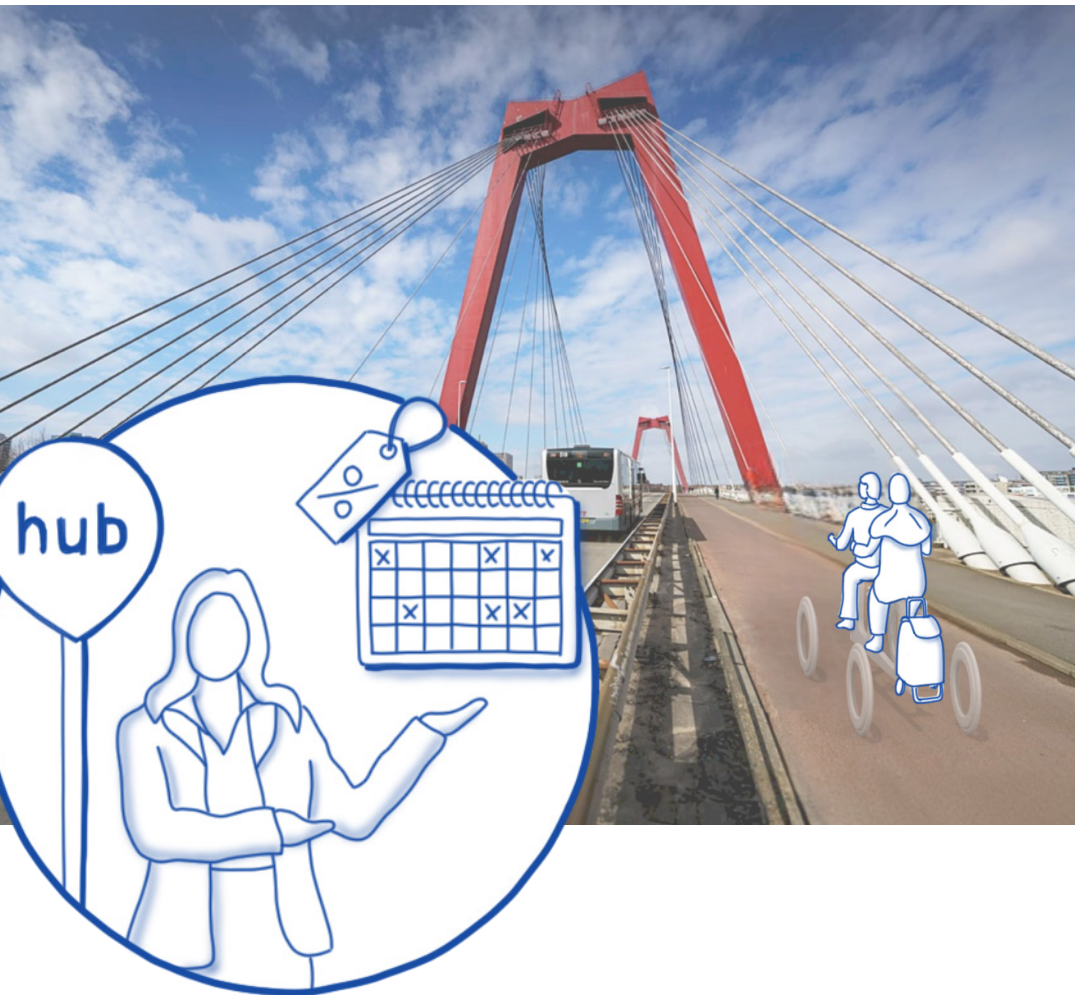


Mobility freedom



Figure 69: Scenario Feijenoord: Mobility freedom

- Two friends want to go to the Blaak market together. At the local hub at the community centre (Huis van de Wijk) in Feijenoord, they try out the bike.
- The bike was not reserved and since they are eligible for free use, they were able to take it lastminute for their trip to the market.



- The ladies never learned to cycle and feel a sense of fear to learn. They therefore make most of their trips by public transport on foot. However, the public transport options are limited in Feijenoord, which limits their mobility freedom.
- This bike is a low-threshold way to discover the freedom that comes with cycling. They can try it together, which makes it more comforting and less of a big step.



- They have bought a lot of groceries at the market, which they take with them in their trolley. The trolley can be placed on the cargo space at the rear of the bike. As they step out of their comfort zone, they have fun trying something new together.

3

M4H

An old man and his neighbour go to a medical appointment



Integration



Figure 70: Scenario Feijenoord. Mobility freedom

- An elderly man has a medical appointment planned. He lives in a car-free area and therefore chooses this bicycle as a convenient means of transport.
- The man made a reservation in advance as the appointment was already scheduled.
- Due to his age, he feels a little insecure when travelling, especially due to all the innovative mobility in the neighbourhood. He is therefore looking for a buddy to accompany him on his journey. He compares the people available as travel partners. Through a personal profile with a photo and reviews from previous rides, he chooses someone he feels comfortable with. This gives him confidence and peace of mind for the journey. He is matched with a neighbour who is willing to share his ride.
- As he has difficulty walking, the neighbour picks up the man with the bicycle in front of his house.



- The old man brings his walking aid, which he can put in the cargo space on the back of the bike.
- They cycle together to the appointment. The old man occasionally pedals along on the bike, but his physical limitations prevent him from doing much himself. However, it does give him the experience of contributing a little.
- During the ride, they get to know each other and get on well.



- The old man goes to his medical appointment, while the neighbour has a coffee with a friend who lives nearby.
- After the appointment they meet again and the old man is dropped off at his home.
- The neighbour receives some credits that he can use for the whole mobility system. At the same time, he feels good helping someone out.
- They get on well and agree to cycle together more often.

Other applications

The above scenarios primarily address the focus points for vulnerable groups: increasing the sense of physical safety, increasing the sense of mobility freedom, and integrating vulnerable groups into an innovative mobility system. However, we argue that the vehicle should also be interesting and relevant for non-vulnerable groups. Through several ideas for modular add-ons, derived from the collected 'wants' during the research phase, additional use cases have been developed to increase the applicability and relevance to the wider public.

In a future where the car plays an increasingly smaller role, a stable bicycle with modular add-ons could be a solution for user scenarios where people would otherwise use a car. Such scenarios are already emerging in M4H, but will eventually be relevant within the whole city.



Figure 71: A father takes his child in a maxi cosi to the park. Since the child is still too young for a bike seat, he attaches the maxi cosi to the bike.



Figure 73: Large items can be carried using a cargo add-on, such as in the case of buying a christmas tree using the bike instead of a car.



Figure 72: A parent brings her daughter and her friends to their hockey training.



Figure 74: A work commuter adds a roof to the bike to avoid getting wet when it rains. This way he arrives neatly at work.



Figure 75: Bringing home a second-hand washing machine that was picked up from someone elsewhere in the neighbourhood who wanted to get rid of it.



Figure 76: A group of youth loitering using the bike to come together and socialise.



Figure 77: Two tourists who are able to do sightseeing while travelling in a fun and social way.



Figure 78: Parcel deliverers struggle with car free areas (Van Noort, 2024). Parcel deliverers can park their van outside the neighbourhood and transfer all packages for the neighbourhood into the cargo trailer. This is relevant for an area such as M4H, but will eventually be relevant throughout the whole city.

6.9 A fit for Louwman Group

This chapter looks into how the envisioned concept aligns with Louwman Group's identity, taking into account the company's mission and essence. The alignment shows that Louwman Group is the right company to take on this mobility solution. This also provides persuasion when talking with a stakeholder such as Gemeente Rotterdam.

Passion to move people

Louwman Group's mission is summed up in the phrase "Passion to move people". It focuses on putting people first and providing suitable mobility for everyone. This mission is about more than just physical transport; it is about touching people's lives, encouraging them and helping them to move freely. Ultimately, mobility is about emotion: a sense of flexibility and the experience of freedom (Louwman Group et al., 2023).

Our concept embodies this mission by addressing the mobility needs and wants of those who often feel excluded by current systems. The stable, modular bicycle is designed with vulnerable groups in mind, ensuring that their needs are met first and foremost. But at the same time it is also relevant to non-vulnerable people, promoting inclusivity and broadening its appeal.

Mobility for life

Louwman Group focuses on the long term and believes in the power of long-term relationships. In a rapidly changing world, Louwman Group aims to provide mobility for everyone. Flexible, sustainable solutions that offer maximum freedom of movement and make everyday life more enjoyable and easier.

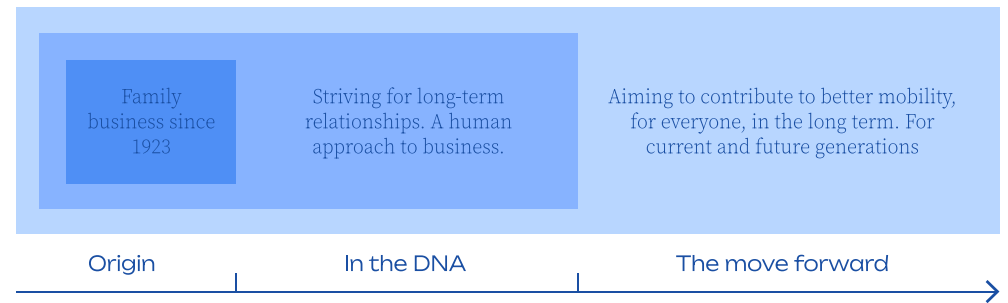


Figure 79: Louwman Group's brand essence connects their origin, the present and the future (Louwman Group et al., 2023)

“ We don't sell cars or bicycles; we offer our customers the possibility to move freely, even if that's less obvious.”

(Louwman Group et al., 2023)

Mobility for Life consists of four pillars, which give concrete meaning to the essence (Louwman Group et al., 2023).

1. *Making everyday life easier and more enjoyable*
Our concept achieves this by providing a solution that is both practical and fun. It makes everyday journeys easier, safer and more comfortable, while adding a social and playful element that makes travelling an enjoyable activity.
2. *Building long-term customer relationships*
On the one hand, relationships are built among the users themselves, stimulating a sense of community and mutual support. On the other hand, this long-term perspective is also reflected in the modular design of the bike, which can adapt to the user's changing needs and desires over time.
3. *Mobility solutions for all stages of life*
The concept is designed to be adaptable and inclusive, making it suitable for a wide range of users, from the elderly and physically challenged people to young adults. This flexibility ensures that the bicycle remains relevant as users' circumstances and wants change.
4. *Working towards sustainable mobility and circular economy*
The concept aims to feel like a bicycle but also offers an environmentally friendly alternative to car travel by reducing our dependence on cars. Add-ons such as cargo or a roof make an interesting alternative for use cases where people would normally use a car. In addition, the modularity ensures that the same base will remain relevant in the future as wants change, making it a sustainable solution for rapidly changing cities.

6.10 Concept evaluation

The concept was evaluated by both Louwman Group and Gemeente Rotterdam. This chapter will describe the general perspectives of both parties on the concept by means of several quotes. In addition, both parties have also raised some points of attention and potential risks, which will be outlined and explained in the recommendations section in Chapter 7.2.

Evaluation at Louwman Group

During the brainstorming session at Louwman Group, we also evaluated the concept. Overall, everyone was very enthusiastic and thought it was very much in line with Louwman Group's vision. What was interesting was that it was noted that if you would pitch the vehicle without explaining the underlying ideas and research, people might not immediately see its strength. However, when you do this kind of research, it creates argumentation which sheds a whole new light on certain vehicles and creates value. This is in line with the essence and goal of this project for Louwman Group: to create a well supported portfolio based on needs and wants. The challenge, however, is to communicate this persuasiveness to potential consumers as well, something that requires further attention in future research.

“ I think it fits in very well with what Louwman stands for. Making mobility accessible to everyone. Based on that, we also have such a diverse portfolio and a huge care division. So it fits very well with us as a company and with our DNA as a family. ”

LOUWMAN

“ Free use if it's not reserved, I immediately think, why aren't we doing that already? You can apply it to a lot more things! ”

“ I think it is a very good approach. Because there is no combination of slower transport, focusing on safety and stability, which is relevant to everyone at the same time. All the other micromobility is aimed very specifically at a young audience, but my grandmother wouldn't use that. ”

“ Gap between car and care. This fits in well with our strategy. We are increasingly shifting our automotive activities towards care and cycling activities. We already have the delta, but not so much in between. ”

Evaluation at Gemeente Rotterdam

In addition to the evaluation with Louwman Group, the concept was also evaluated with two people of the shared mobility team at Gemeente Rotterdam. They were also positive about the core of the concept. However, they indicated that to comment further on the feasibility of the concept, the implementation of the entire concept including services would need to be more detailed, which falls outside the scope of this project. Speaking from other experiences, it became clear that concepts could either succeed or fail in the area of implementation.

“Inclusivity is also a high priority for Gemeente Rotterdam. So it definitely fits in with our vision.”

“The insights you have found are very recognisable. What you say about the three neighbourhoods is something I can relate to from various projects I've done there.”



**Gemeente
Rotterdam**

“If you look at the care sector, there is the WMO group (Wet Maatschappelijke Ondersteuning). These are people who have been officially designated by the government as having a physical or mental disability that prevents them from travelling independently. This group is entitled to special transport. But there is also a large group of people who fall just outside this category but still experience many challenges when it comes to mobility. I think this concept is very interesting to address the needs of these people, as they often feel left out.”

“I think a credit system is a good solution. Many shared mobility providers already work with a credit system. There are always people who are attracted to that, so this proves that people are open to it. The credit system might be the crux of your concept.”

Feasibility, viability, desirability

Based on the evaluation with Louwman Group, Gemeente Rotterdam and own input, the feasibility, viability and desirability of the concept is evaluated below. Specific focus points will be addressed more concretely in the general discussion in Chapter 7, which will highlight the areas that need attention to make certain elements more feasible, viable, or desirable.

Feasibility

From the perspective of implementation by Louwman Group, the feasibility of the concept heavily depends on which scenario is pursued. Scenario 2 may be less feasible from Louwman Group's perspective, primarily because the company has less experience in this field. Additionally, it remains to be seen whether other parties that could potentially develop this product would find it interesting to create a product initially focused on the Dutch market. Scenario 1, on the other hand, seems more feasible.

However, Louwman Group has extensive experience in setting up support services. Many companies under the Louwman Group umbrella possess expertise relevant to the concept. Objectively, looking at the bicycle itself, regardless of the scenario followed, it appears technically feasible. Market research shows that many existing products come close to the desired combination of features, but none yet offer the complete package. The biggest challenge will be ensuring that these modular components are easy to add and remove while staying robust and minimising maintenance.

Feasibility also closely ties to the policy and infrastructure within the context of Rotterdam, which plays a crucial role in the success of the concept. For example, the establishment of a network of hubs is already part of the municipality's vision. Therefore, the question is not whether there will be hubs that could facilitate this concept, but rather how this concept can be integrated into these hubs. Elements such as the overarching credit system, reduced fares, and who qualifies for that, pose larger challenges. Besides that, the spontaneity associated with the reduced fare is contrary to the lifestyle of many vulnerable people. The physical aspect and the opportunity to use the service on location also mean that there need to be people who can fulfil these supportive roles.

Viability

Although Louwman Group is a socially oriented company, it remains a commercial enterprise. Therefore, Louwman Group indicated during the brainstorm that it is essential to prove that the target group of vulnerable people is large enough or that the concept is attractive to a broader audience. Considering vulnerable groups, we see that with an ageing population, this group is growing, but besides that, the concept is also relevant for non-vulnerable groups. The concept's success will depend on effectively communicating its value proposition to these diverse user groups.

The costs of such a concept are expected to be relatively higher than other shared mobility solutions, especially considering modular add-ons. Offering affordable mobility will strongly depend on whether government grants, aimed at improving sustainable urban mobility and inclusivity, can be applied.

Moreover, it is crucial that the concept remains relevant in the future. The modular add-ons allow the concept to be adaptable, but it also depends on the ability to continue operating in a city. This requires winning tenders from the municipality, which are awarded every five years. Therefore, Louwman Group must continually prove its relevance in the future. Also, the relevance of the concept in other cities plays a role. Scalability and applicability to other areas can make it more viable for Louwman Group.

Desirability

This concept is based on the needs and wants of the envisioned target groups. By focusing strongly on these aspects during the design process, the developed concept is expected to be desirable. However, the desirability needs to be further tested on a broad range of both vulnerable and non-vulnerable groups in follow-up research. This also involves in-depth research on the modular add-ons.

During this research, an intentional effort was made to deeply explore needs and wants, and to uncover underlying motivations. As a result, people may not immediately recognize the value of the concept but may still have these needs or wants. As discussed earlier in this report, people often experience a 'status quo bias' in mobility; they tend to stick to the familiar due to the comfort it brings, and change requires mental effort (Hazan et al., 2020). The presentation of the concept to potential users is also crucial. The 'anchoring bias' plays a role here. In decision-making, people often heavily rely on a single piece of information, known as anchoring, typically the first information they encounter. This tendency can impede the adoption of new mobility modes (Hazan et al., 2020). People need to be made aware of the concept's existence and its potential benefits for them. This applies to both vulnerable and non-vulnerable groups.

The desirability can also be influenced by the extent to which a sense of social inequality may arise from the use of add-ons and a credit system where people need to 'work' to use the bike or certain add-ons.

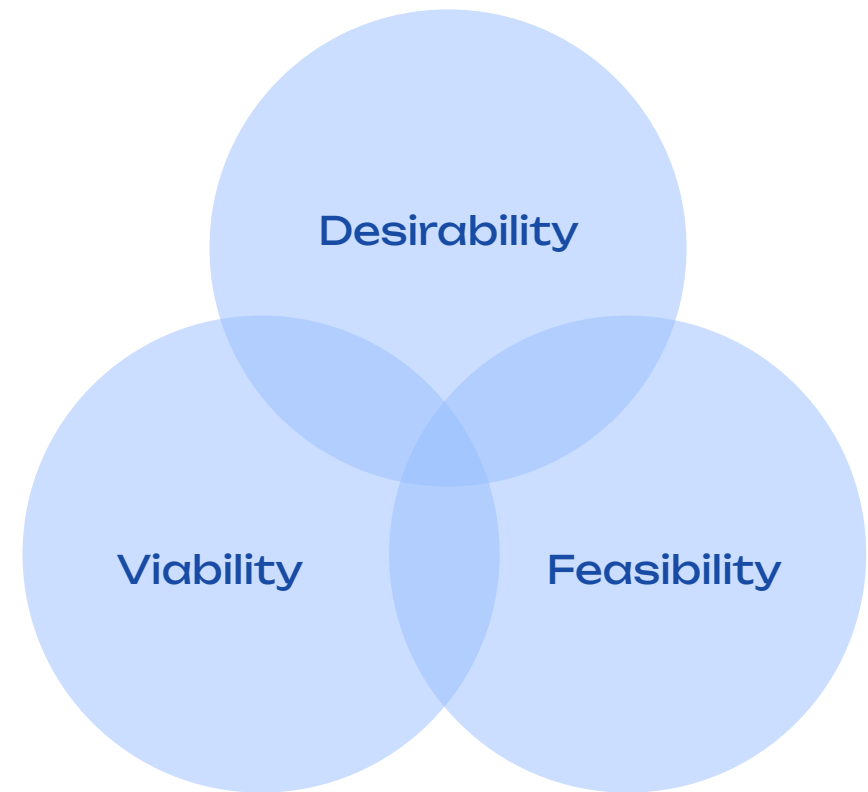


Figure 80: Sweet spot for innovation

6.10 Conclusion and evaluation

Conclusion and follow-up steps

This chapter has outlined the creation of the concept. It describes the essential elements required for the concept to be effective. These are a physical product combined with several service elements. Two possible scenarios for the physical product have been highlighted. At present, no vehicle has been found that is predicted to achieve the desired effect. However, this is a snapshot in time and other promising products may come to market in the near future. A possible suitable vehicle could be tested for effectiveness in pilot projects. Partnering with a company to co-develop a vehicle is also an option. Although this approach differs from Louwman Group's typical way of working, it could be an interesting strategic move. In Chapter 6.10, the concept is evaluated in terms of feasibility, viability, and desirability. This evaluation raises several questions that remain unanswered at the moment. In Chapter 7.2, these questions will be addressed with recommendations, outlining potential directions and ideas to tackle these issues.

- How do vulnerable groups come into contact with the concept?
- How do you reach and convince non-vulnerable groups?
- How feasible is an overarching credit system?
- Who qualifies for free or reduced fares?
- How do you deal with the spontaneity associated with the reduced fare?
- What will be the role of Louwman Group?
- What is the relevance of the concept in other cities?
- How to fill in supporting roles for the concept to work?
- Where to store and park the bicycles?
- What are suiting add-ons?
- How to deal with social inequality through add-ons and a credit system?
- To what extent can the concept be offered affordably?

Approach iterations and considerations

During this design phase, a lot of effort was put into determining the most valuable concept elaboration for Louwman Group. Initially, a more detailed exploration of what the bike could look like was considered, but it turned out that this might not be the most valuable way forward. By creating the two scenarios, a good middle ground was found, giving Louwman Group an initial insight into possible approaches and inspiring further development. In order to address both scenarios, it was finally decided to use an abstract visualisation of a bicycle in the scenarios. This is intended to illustrate the use of the product rather than the design. Therefore, the design of this abstract visualisation is deliberately not elaborated further.

Approach limitations

Exploration at a preliminary stage: The development of both scenarios was approached at a reasonably preliminary level. For example, the exploration of configuration options in Scenario 2 was explored at a basic level. This will involve more complexity, and with a more extensive study, more creative solutions could also be considered. For example, stability is currently determined by the number of wheels and the centre of gravity of the occupants, but stability could be improved in other creative ways as well.

Market overview may be incomplete: Despite considerable efforts to obtain a comprehensive overview of potentially interesting market matches, it is possible that promising vehicles have been overlooked.

Recommendations and scalability remarks

Recommendations and scalability remarks of the concept will be discussed in detail in Chapter 7.

Conclusion, discussion, recommendations & limitations



Figure 81: Rotterdam skyline (Bos, 2016)

7.1 Conclusion

As outlined in the introduction to this report, Louwman Group aims to gain a better understanding of the types of mobility that meet the needs and wants of diverse travellers in a rapidly changing world. This is in line with the theme of personalisation vs generalisation, with the aim of providing better suiting mobility solutions in a feasible and scalable way. With a forward-looking strategy, Louwman Group will be able to identify the types of micro-mobility that will be relevant beyond their current, more short-term approach.

This project investigated mobility needs and wants in three diverse neighbourhoods in Rotterdam in four phases. In Phase I, city level desk research helped to identify interesting neighbourhoods with different profiles. The selected neighbourhoods were Dijkzigt/Nieuwe Werk, Feijenoord and M4H. In Phase II, in-depth field research provided a detailed understanding of each neighbourhood. A wealth of information was gathered through observations, surveys and interviews, which was then analysed in Phase III. Thematic analysis provided clarity of the data, highlighting the differences and similarities between the three neighbourhoods through clustering and plotting on axes.

The results showed that vulnerable groups are excluded from the mobility system in different ways in each neighbourhood. In Dijkzigt/Nieuwe Werk, people feel physically unsafe on the crowded cycle path between fast and antisocial two-wheelers. In Feijenoord, people feel restricted in their mobility freedom due to both personal and external restrictions. In M4H, it is predicted that with the current mobility strategy, vulnerable groups will feel excluded from the innovative mobility system. Within these results, vulnerability is interpreted as a broad and diverse spectrum, ranging from highly vulnerable to not vulnerable.

The resulting idea for a product/service concept, allows Louwman Group to address the issues faced by this range of vulnerable groups, while also catering to non-vulnerable groups. This addresses personalised mobility in a generalised way, which was part of the initial challenge. The concept consists of a modular, stable bicycle with complementary service elements. This concept primarily addresses the needs

and wants of vulnerable groups while also being relevant to non-vulnerable groups, thus creating a solution which is as inclusive as possible.

In terms of the features of a bicycle that would work effectively within this concept, no existing product was found that optimally met these requirements. So we can say that this research identified needs and wants for which the proposed mobility solution did not yet exist. Reflecting on the initial brief, it can be said that by looking beyond existing business models, Louwman Group is able to stay ahead in the mobility transition.

7.2 Discussion & recommendations

As described in the concept evaluation, a number of points of attention relating to the degree of its success emerged. This chapter will first address these questions at concept level and provide some ideas and recommendations. This is relevant for several stakeholders, including Louwman Group, Gemeente Rotterdam or other parties interested in the field of inclusive mobility. Subsequently, a broader and more overarching perspective will be taken on the process and how it can be scaled and applied to other areas. This is particularly interesting for Louwman Group.

Concept: recommendations and points of attention

How do vulnerable groups come into contact with the concept?

Gemeente Rotterdam emphasises the importance of the practical aspect of the concept. How do people come into contact with the concept? How do they get to know it? How can it be ensured that when such a concept is introduced in a city like Rotterdam, it is accessible through existing services and channels in a neighbourhood, so that people can actually find it? And how can they be encouraged to try it in an easy and accessible way? Besides the Huizen van de Wijk, with which vulnerable groups are often familiar, another interesting party could be the Vraagwijzer of Gemeente Rotterdam. The Vraagwijzer is present in every district of Rotterdam and is there to answer questions about, for example, health care, financial matters, legal advice, housing situation or activities in the neighbourhood (Gemeente Rotterdam, n.d.-d). The Vraagwijzer could play a role in raising awareness of the concept among vulnerable groups and explaining how it works. In addition, when using the matching process, vulnerable people may be reluctant to ask someone to accompany them on a cycle ride and to ask someone a favour with this. The desirability of the concept for a diverse group of vulnerable people needs to be tested.

How do you reach and convince non-vulnerable groups?

In addition to making vulnerable groups aware of the existence and use of the concept, the same applies to non-vulnerable groups. The focus here is on the versatility and usability of the bicycle, and encouraging people to take on the role of travel partner.

How do you spread the story and the message? This goes back to the insight from the Louwman brainstorm, where the value of such a bike was recognised after hearing the underlying concept. If people are not aware of the thought behind the concept and its usefulness in different use cases, they will not see the added value of using it. The desirability of the concept for non-vulnerable groups needs to be tested. The usability and versatility of the concept can be spread by using marketing strategies to communicate the underlying concept and its benefits. This can include social media campaigns, local events, or partnerships with local businesses. Promoting the role of travel partner can be encouraged by highlighting how this is a relatively low key way to do something good for someone, while earning credits at the same time.

How feasible is an overarching credit system?

Gemeente Rotterdam points out that an overarching credit system could work very well, but it still takes a long time before it will work with MaaS. In the meantime, something else would have to be implemented. They could start by using the credit system internally, just for this bike and its associated add-ons, until an overarching system is supported. Such a credit system approach is already widely used by other shared mobility providers and has proven its effectiveness.

Who qualifies for free or reduced fares?

According to Gemeente Rotterdam, this is a major challenge. How do people who fall within such a broad spectrum of vulnerability qualify for a reduced rate? People who qualify for financial support can clearly demonstrate their vulnerability when it comes to disposable income, but as this concept focuses on a wider spectrum, it becomes difficult to determine who qualifies and who does not. What criteria do you use? By conducting intake interviews, a clearer picture of someone's personal situation can be gained. However, this process is quite time consuming and subjective. By establishing guidelines, this process can be made more systematic. Further research is needed to determine the specific guidelines for this purpose.

How do you deal with the spontaneity associated with the reduced fare?

When considering the last minute booking aspect that comes with the free or

reduced fare, Gemeente Rotterdam points out that their research has shown that vulnerable people tend to plan with a very high margin of safety. Someone with a physical disability will only travel if they are sure the journey will be successful. This is also the case for people with a lower disposable income, who are concerned about possible extra costs. The service around the reduced fare aims to encourage spontaneous use, whereas vulnerable groups often tend to overplan. Furthermore, this approach actually reduces the opportunity for non-vulnerable people to use the bicycle last minute, whereas this group is more likely to make last-minute mobility decisions. With real-time availability information, transparency can be created which helps users to make spontaneous decisions. However, the extent to which this poses problems needs to be determined through practical pilots.

What will be the role of Louwman Group?

The concept consists of a physical product and a service. A strategic decision has to be made about Louwman Group's role in this. While they could build the service around the product themselves, it is also possible to let another party take care of this aspect. In this scenario, Louwman Group could supply the bicycles to another operator, thus transferring the role of risk bearer to another party. This approach may be more in line with Louwman Group's DNA, where they recognise the market but act as a supplier or importer. It is also a strategic consideration whether to promote the concept prominently under the Louwman Group brand name or to keep the branding more in the background.

What is the relevance of the concept in other cities?

Scalability is crucial for Louwman Group. The next step would be to investigate the relevance of the concept in other cities. Vulnerable groups exist everywhere, but the proportion of vulnerability types may vary, which possibly makes different themes more relevant in other cities. By using the modular add-on system, the concept could be personalised for different municipalities. In the end of this chapter, a recommendation is made on how to systematically map the needs and wants in other areas.

How to fill in supporting roles for the concept to work?

Gemeente Rotterdam has found that previous concepts have failed because it was not properly considered who would fulfil the supporting roles within the system. Particularly in relation to the Huizen van de Wijk, it is often assumed that the staff can take on additional tasks while they actually do not have the time. Who maintains the bicycles? Who helps with the physical reservations? Who helps with the modular add-ons? Louwman Group could potentially fill these roles by creating its own pool with employees. In addition, there is an interesting opportunity to also involve vulnerable people in these roles, such as at-risk youth from the neighbourhood, adding a social aspect to the implementation of the concept. Future research should focus on how this should be organised.

Where to store and park the bicycles?

As Louwman also pointed out, it needs to be considered where the bike can be parked and stored. On the one hand, this involves space at the mobility hubs, including space for add-ons and changing. On the other hand, it is about parking in the city. Even though the bike can be relatively narrow (less than a metre, looking at existing bikes) there still needs to be enough suitable space in public areas for parking. This is a problem that Fietsmaatjes is currently experiencing as well. In addition to looking for volunteers, they are also looking for (covered) places to store their bicycle. In the future, however, there will be significant changes in the amount of space available in the city. The less prominent the role of the car in the city, the more space will be available, such as car parking spots and main roads.

What are suiting add-ons?

This research has looked at neighbourhood specific wants, and based on this, some ideas for modular add-ons have been created. These add-ons are fairly straightforward and are mainly used to demonstrate what is possible. However, more research is needed in this area. Also, what kind of add-ons are versatile and could target multiple use cases for the most efficient use?

To what extent can the concept be offered affordably?

Research needs to be conducted to determine potential usage rates. This segment is likely to be more expensive than shared scooters and bicycles. In addition, it is important to investigate the feasibility of offering bicycles for free or at a reduced rate if they are not reserved. Perhaps some subsidy or funding for social initiatives from the municipality or government could be used for a concept like this. However, the applicability to a wider audience makes qualifying for such a subsidy more complex.

How to deal with social inequality through add-ons and a credit system?

A potential downside of modular add-ons could be that they create a division based on which add-ons people can afford. You want to make sure that people with less disposable income can use the add-ons as well. This could potentially be addressed by also using the credit system and discounts for low-income people. However, it is also important to avoid a situation where people who cannot afford the add-ons have to 'work' in order to make use of them. Just like qualifying for free or reduced usage, the free or discounted use can also be applied on add-ons. Looking at the credit system, De Ruijter et al. (2024) suggests that the ridesourcing market tends to thrive on areas with high social inequality. On the one hand, this means that such a system will work well in a city with different income levels. On the other hand, there is an ethical need to ensure that the system does not exacerbate this inequality. Again, by emphasising the social aspect and an opportunity for low-threshold volunteering, it can become a role that some people take on more out of charity than to earn credits.

How do you ensure that the matching process is not misused?

One risk of the matching process is that people may have potentially bad intentions, especially when vulnerable groups are involved. To prevent this, there needs to be a lot of transparency around the matching process. Through a personal profile with reviews of previous rides and a photo, people can assess whether they feel comfortable with a certain travel partner. After all, you are giving up some of your autonomy. However, this system is not completely foolproof and there is still potential for abused use. Therefore, further development on that aspect is needed as well.

Recommendations on scalability

Applicability of the approach to other areas

This project focused on the context of Rotterdam, specifically three different neighbourhoods. This context was chosen to show how mobility values can vary within a city that is very car-friendly at the same time. This makes the chosen context particularly interesting, but also relatively complex for finding commonalities. On the other hand, designing for 'extreme' profiles with strong characteristics may make it easier to get a clear picture of a neighbourhood than for a more moderate profile.

This research can also be applied to other neighbourhoods in Rotterdam or even other cities. This increases its scalability and makes it particularly interesting for Louwman Group. The conclusions of each phase have already gone into this in more detail.

Generalised model

The axes of the scales are currently constructed from the contradictions found during this research. A next step could be to extend this to a broader set of indicators, making them more comprehensive and therefore more relevant and applicable to a wider variety of areas, rather than just based on the differences between Dijkzigt/Nieuwe Werk, Feijenoord and M4H. This creates a generalised model that provides a more complete picture of potential area characteristics.

In addition, for each position on each axis, you could establish standardised corresponding wants. Once this is set up, the approximate position of a neighbourhood on a scale can easily be translated into wants (Figure 82). There is, however, a risk that the results will be too generic and that important distinctive elements of an area will be lost. The effectiveness of this approach would need to be investigated. Although it may take some time to build the model initially, it can then be easily reused.

For future research on other areas, you can focus the fieldwork more directly on

identifying the area's position on these axes, making this stage more efficient than the execution in this project. Another option is to have the positioning done by local experts, such as someone working in a community centre or a member of the neighbourhood council.

Once the area has been positioned on each axis, you can collect the corresponding needs for each axis. This way, you can easily create a unique profile for a neighbourhood. While a persona for a neighbourhood can often be somewhat simplistic, this method allows you to create a unique profile based on specific characteristics.



Figure 82: An idea for a generalised model to simplify the identification of needs and wants. Add scales, and set up standardised wants for each position on each scale.

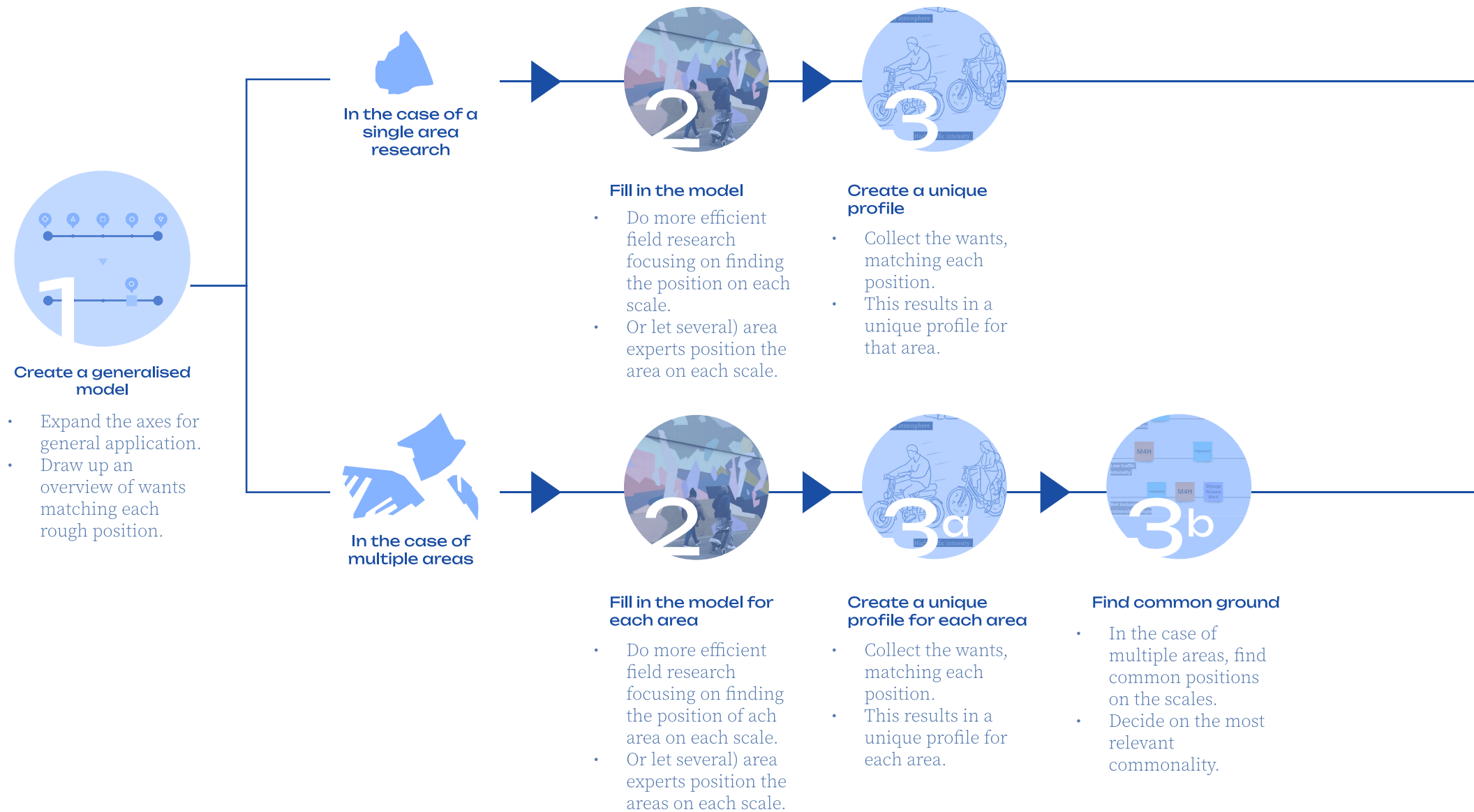
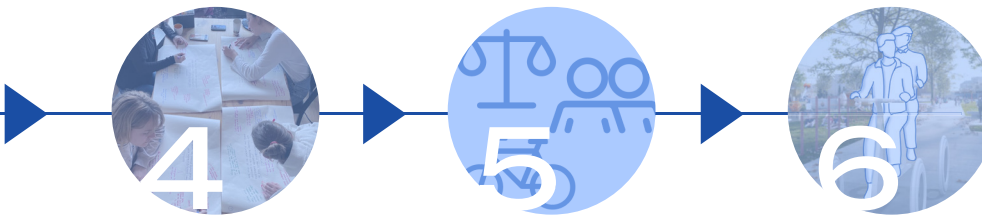


Figure 83: The potential use of a generalised model in the total process.

◀ Finding argumentation for current mobility solutions in portfolio



Decide on a design goal based on unique profile

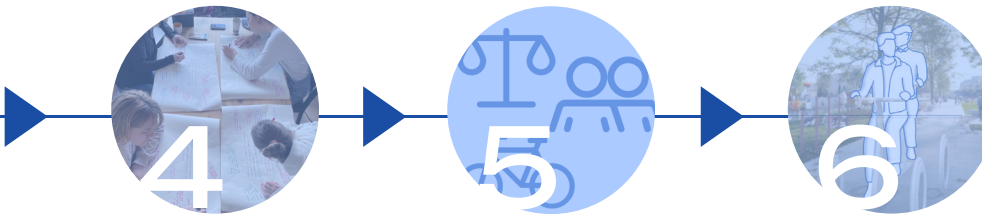
- Create a design goal what an envisioned concept should achieve.

Identify concept features

- Based on the envisioned experience, use and interaction with the concept, identify what kind of concept features are desired.

Generate a suiting mobility solution

- Scenario 1: look for existing products doing the job.
- Scenario 2: Develop a new product in case nothing exists.



Combine differences and commonalities to decide on a design goal.

- Identify for each area how the commonality is being experienced and how it differentiates each area.
- Create a common design goal what an envisioned concept should achieve.

Identify concept features

- Based on the envisioned experience, use and interaction with the concept, identify what kind of concept features are desired.

Generate a suiting mobility solution

- Scenario 1: look for existing products doing the job.
- Scenario 2: Develop a new product in case nothing exists.

Adding new mobility solutions to portfolio ►

Justification of the current portfolio

This approach can also help to strengthen the justification of Louwman Group's current portfolio. By working backwards in Figure 83, a specific mobility solution can be segmented into concept features, which can then be linked to needs and wants, providing a rationale for who, what, where and why this mobility solution is suitable. Gaps and opportunities in the current portfolio can also be more clearly identified this way. This helps Louwman Group to develop a more complete and better justified portfolio, which is part of the initial project assignment.

Direct applicability

For direct applicability to other areas, there are often neighbourhoods in other cities with comparable profiles where many similarities can be found. For example, Louwman Group is currently working on a shared mobility project in the Merwedekanaalzone in Utrecht, where many similarities with M4H have been found. However, this applicability is limited.

Dynamic Mobility Solutions

Lastly, further research is needed on how to continuously track needs and wants. Instead of creating a one-time snapshot with a vision for the future, it is desirable to continuously update changes, especially in rapidly evolving urban environments. Even though future changes are taken into account, unexpected factors can significantly influence mobility needs and wants. Think of technological breakthroughs, policy changes, social trends, or a pandemic like we experienced with Covid-19. It is essential to have a flexible and adaptive system that can quickly respond to these changes to continue providing effective mobility solutions.

7.3 Limitations

Throughout the report, each stage has addressed the limitations relevant to that specific stage. This chapter takes a broader view of these limitations and how certain issues may have influenced the final outcome.

Neighbourhoods with 'extreme' characteristics

The selection of three contrasting neighbourhoods makes it easier to create a characteristic profile. This helps to create a clear picture of what to design for. However, if you were to study neighbourhoods with more moderate profiles, it might be more difficult to translate this during the design phase. While it may be easier to find commonalities, it becomes more difficult to address the personalisation aspect.

Researcher bias

Another factor to consider is the potential for researcher bias. Despite efforts to avoid forming prejudices about neighbourhoods, some degree of generalisation is sometimes necessary to be able to interpret data, draw conclusions, and paint a picture of an area. This generalisation and emphasis on certain characteristics could influence conclusions and the focus. As a result, some characteristics may have been exaggerated and this may have influenced decisions made during the process.

Available data

The selection of the three neighbourhoods was based on the available data, which could have influenced the selected neighbourhoods. With more or different data, different neighbourhoods might have been chosen, resulting in different themes. Although the final selection of neighbourhoods is diverse as intended, different neighbourhoods could have led to a different design direction. This isn't necessarily a matter of right or wrong; the research could be conducted with any set of neighbourhoods. However, the neighbourhoods chosen certainly determined the direction of the research. In other neighbourhoods, vulnerable groups could also have played a role but perhaps with other themes within the spectrum of vulnerability.

Number of neighbourhoods

Three neighbourhoods were chosen for this project. However, the study can be conducted for more or fewer areas as well. A larger number of areas would make it harder to find commonalities, or the commonalities would be more generic, making it possibly harder to identify gaps in the current mobility offer that could be addressed.

Design direction for vulnerable groups

The source of the information collected may have influenced the design direction. Conducting interviews in the Sociaal Café in Feijenoord mainly resulted in talking to vulnerable people, as people on the street were less interested in getting involved. Ideally, the demographic information of the participants should have been scaled to the actual demographic proportions in the neighbourhood to determine which themes were most relevant at that scale. In addition to the interviews in Feijenoord, the interview with Beer Pijpker from Fietsschool010 and Gemeente Rotterdam about M4H also influenced the focus on vulnerable groups, as this is a big challenge in the current strategy for the neighbourhood. As a result, the issues concerning vulnerable groups quickly became important in the overall project.

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Appendix A: Hub types scope

Looking at the overview of hub types, drawn up by the KiM Netherlands Institute for Transport Policy Analysis, we can state that the focus of this project is mainly on urban neighbourhood hubs, urban district hubs, and city hubs. However, it must be taken into account that this overview indicates the current view of hubs in the Netherlands. In a future scenario where car-free cities are more common, this overview is likely to change. For example, solutions will also need to be found in the field of inner city freight transport, such as the use of Light Electric Freight Vehicles (LEFV's). This may result in the addition or integration of smaller distribution points in the middle of the city to this overview. Also, it must be taken into account that this overview of hubtypes is a more classical approach on hubs. This does not mean that within this project, the focus will ultimately be on a hub that perfectly falls into one of these categories. It serves more as an indication of the direction in which this project is heading.

	Description	
Passenger transport		
<i>Neighbourhood hub</i>	<i>Small-scale hub in a residential area</i>	<i>In scope</i>
<i>District hub</i>	<i>Large-scale hub in a residential area</i>	<i>In scope</i>
<i>Regional hub</i>	<i>Hub in rural area with a focus on public transport</i>	<i>Out of scope</i>
<i>Urban periphery hub</i>	<i>Hub located near a city on or before the ring road</i>	<i>Out of scope</i>
<i>City hub</i>	<i>Large-scale hub in the city centre</i>	<i>In scope</i>
<i>(Inter)national passenger hub</i>	<i>E.g. Schiphol</i>	<i>Out of scope</i>
Freight transport		
<i>Urban distribution centre</i>	<i>Transfer centre on the outskirts of a city</i>	<i>Out of scope</i>
<i>Regional distribution centre</i>	<i>Transfer centre located outside the city, serving more than one city or core</i>	<i>Out of scope</i>
<i>(Inter)national freight hub</i>	<i>E.g. Port of Rotterdam</i>	<i>Out of scope</i>

Appendix B: Districts and neighbourhoods within the Rotterdam ring

Overview of the districts and neighbourhoods within the Rotterdam Ring (Gemeente Rotterdam, 2022a).

District	Neighbourhoods
Pernis	<ul style="list-style-type: none"> - Pernis
Charlois	<ul style="list-style-type: none"> - Carnisse - Heijplaat - Oud-Charlois - Pendrecht - Tarwewijk - Wielewaal - Zuiderpark en Zuidrand - Zuidplein - Zuidwijk
Feijenoord	<ul style="list-style-type: none"> - Afrikaanderwijk - Bloemhof - Feijenoord - Hillesluis - Katendrecht - Kop van Zuid - Kop van Zuid-Entrepot - Noordereiland - Vreewijk
IJsselmonde	<ul style="list-style-type: none"> - Groot IJsselmonde-Noord - Groot IJsselmonde-Zuid - Lombardijen - Oud IJsselmonde

District	Neighbourhoods
Delfshaven	<ul style="list-style-type: none"> - Bospolder - Delfshaven - Middelland - Nieuwe Westen - Oud Mathensse / Witte Dorp - Schiemond - Spangen - Tussendijken - Nieuw Mathensse
Centrum	<ul style="list-style-type: none"> - Cool - CS-kwartier - Nieuwe Werk / Dijkzicht - Oude Westen - Stadsdriehoek
Kralingen Crooswijk	<ul style="list-style-type: none"> - De Esch - Kralingen Oost / Kralingse Bos - Kralingen-west - Nieuw Crooswijk - Oud Crooswijk - Rubroek - Struisenburg
Noord	<ul style="list-style-type: none"> - Agniesebuurt - Bergpolder - Blijdorp / Blijdorpsepolder - Liskwartier - Oude Noorden - Provenierswijk

Appendix C: Data details for each area selection criterion

1. Diversity in demographic factors
 - *Age*: number of residents on 1 January 2023 by age group (Centraal Bureau voor de Statistiek, n.d.).
 - *Income*: Standardised household income is the disposable income adjusted for differences in the size and composition of the household, allowing for a comparable level of prosperity to be reflected, regardless of household size and composition. Low, middle, and high household incomes are delineated based on the national distribution of household incomes. Incomes for tax year 2018 (CBS, 2018).
 - *Household composition*: divided into single household; couple, no child; couple, child(ren); single-parent household (BRP, 2021).
2. Diversity in types of travellers
 - *Residents, visitors, commuters*: based on the number of addresses per use purpose for the 10 most uses per neighbourhood. Examples include residential function, industrial function, and education function. Data from the BAG, December 2024. Even though the address function is not directly representative of the distribution of the type of travellers, it still gives an indication.
 - *Main facilities*: an overview of important main facilities that result in a significant number of travels, such as a stadium, tourist attraction or large shopping centre. This was determined simply by exploring the facilities in the area on Google Maps.
3. Diversity in current mobility use
 - *Registered vehicles*: the number of vehicles registered in December 2023 in the RDW registration register in this area.
 - *Car density*: The number of passenger cars per km² of land in January 2023. The number of passenger cars by area is, together with other density measures, a measure to represent the concentration of human activities. Data is based on the RDW's vehicle registration.
4. Diversity in development plans
 - *Existing area, transformation area, new area*: to what extent are developments planned in the area which will influence the type of travellers? This could be a completely new residential area targeting a new group of people or a new facility that will attract many visitors to the area, or the area will remain virtually the same. This was determined in various ways. Most information was gathered from Gemeente Rotterdam, project developers, and woneninrotterdam.nl, where all planned new housing developments in Rotterdam can be found.
5. Diversity in mobility quality
 - *Metro, train, water infrastructure*: To what extent is current public transport provided? Are there many options that make the area accessible or is the area more remote? This was determined simply by exploring the public transport and infrastructure in the area on Google Maps.

Appendix D: Neighbourhood selection data sheets

Comparing districts within the Rotterdam ring

			Pernis	Charlois	Feijenoord
Criteria based on usergroup					
Diversity in demographic data	Age	0-15:	15,28%	16,96%	16,82%
		15-24:	10,63%	13,31%	13,56%
		25-45:	26,52%	34,73%	31,89%
		46-65:	28,14%	22,89%	24,42%
		65+:	19,53%	12,12%	13,32%
	Income	Lowest 40%:	35%	62%	65%
		Middle 40%:	46%	31%	25%
		Highest 20%:	19%	7%	10%
	Household composition	Single household:	34%	50%	46%
		Couple, no child:	30%	18%	19%
Couple, child(ren):		26%	17%	19%	
Single-parent household:		9%	13%	14%	
Diversity in types of travelers	Residents, visitors, commuters	Residential addresses:	89,69%	91,86%	92,72%
		Addresses with shopping/meeting/sport/logies function:	2,01%	3,48%	3,20%
		Addresses with office/industrial/educational function:	4,03%	5,25%	5,91%
Main facilities			Zuiderpark, Ahoy, Zuidplein	Katendrecht, Hogeschool InHolland, Ikazia ziekenhuis, De Kuip	
Diversity in current mobility use	Registered vehicles	Car	64,96%	72,66%	73,09%
		Moped	16,62%	12,81%	15,46%
	Car density	Cars / km ²	1454	1956	3469
Criteria based on location and integration					
Diversity in development plans				Carnisse Eiland	Rijnhaven, Transformatie Codrico
Diversity in mobility quality	Metro Infrastructure	Metro stations	Pernis	Maashaven, Zuidplein, Slinge	Wilhelminaplen, Rijnhaven
	Train infrastructure	Train stations			Rotterdam Zuid, Rotterdam stadion
	Infrastructure water	Water connection	Maas	Maashaven	Maas

IJsselmonde	Delfshaven	Centrum	Kralingen Crooswijk	Noord
17,74%	14,66%	7,94%	12,56%	11,91%
11,77%	15,44%	18,41%	21,52%	14,06%
28,62%	36,21%	42,60%	31,31%	41,74%
24,45%	23,16%	19,42%	20,21%	21,16%
17,43%	10,53%	11,62%	14,41%	11,11%
55%	60%	42%	53%	49%
34%	29%	32%	28%	33%
10%	11%	27%	19%	18%
43%	51%	59%	57%	54%
21%	19%	24%	20%	22%
20%	17%	9%	13%	14%
15%	12%	6%	8%	8%
89,12%	91,31%	80,29%	90,68%	91,56%
2,21%	4,02%	10,41%	3,32%	4,15%
5,90%	6,13%	11,61%	10,16%	4,46%
De Kuip, Maasstad Ziekenhuis	Keilewerf	Euromast, Het Park, Erasmus MC, museumdistrict, Koopgoot, Kijk Kubus, Markthal, Laurenskerk, Centraal station	EUR, kralingse bos/plas, sportvelden	Diergaarde Blijdorp, Vroesenpark
72,38%	76,08%	78,20%	76,68%	75,20%
16,24%	13,54%	14,59%	13,72%	14,03%
1892	3886	3267	1551	2854
Feyenoord city	M4H	Schiekadeblok, Parkhaven	Nieuw Kralingen, Brainpark I	ZOHO, Pompenburg
	Delfsehaven, Marconiplein	CS, Eendrachtsplein, Dijkzigt, Leuvehaven, Coolhaven, Stadhuis, Beurs, Blaak, Oostplein	Gerdesiaweg, Voorschoterlaan, Kralingse Zoom	Blijdorp
Rotterdam Lombardijen, Rotterdam stadion		Centraal Station		
Maas	Maas	Maas	Maas	

Comparing Feijenoord, Dijkzigt/Nieuwe Werk and M4H

			Feijenoord	Dijkzigt / Nieuwe Werk	M4H
Criteria based on usergroup					Doelstelling
Diversity in demographic data	Age	0-15:	19,95%	5,54%	Ouderen
		15-24:	14,11%	21,02%	Starters
		25-45:	27,71%	44,34%	Kleine huishoudens
		46-65:	25,14%	18,48%	
		65+:	13,02%	10,62%	
	Income	Lowest 40%:	77%	32%	Sociale huur en dure koop
		Middle 40%:	18%	29%	huur en koop
		Highest 20%:	5%	39%	
	Household composition	Single household:	43%	64%	x
		Couple, no child:	14%	27%	x
Couple, child(ren):		22%	6%		
Single-parent household:		19%	2%		
Diversity in types of travelers	Residents, visitors, commuters	Residential addresses:	94,85%	81,80%	x
		Addresses with shopping/meeting/sport/logies function:	1,33%	7,94%	
		Addresses with office/industrial/educational function:	8,87%	25,82%	x
	Main facilities		Dicht bij de Kuip	Museumpark, Erasmus MC, Het Park, Euromast	Culturele hotspots, creatieve industrie
Diversity in current mobility use	Registered vehicles	Car	75,03%	77,94%	
		Moped	12,20%	12,67%	
	Car density	Cars/km ²	3111	1583	
Criteria based on location and integration					
Diversity in Development plans			Veel nieuwbouw, nieuwe stadsbrug	Museumpark	Volledig nieuw autoluw woon/werk gebied
Diversity in mobility quality	Metro Infrastructure	Metro stations		Eendrachtsplein, Dijkzigt, Coolhaven	Marconiplein
	Train infrastructure	Train stations	Station Rotterdam Zuid		
	Infrastructure water	Water connection	Maas	Maas	Maas

Appendix E: Survey questions (Dijkzigt/ Nieuwe Werk - resident example)



Dijkzigt and Nieuwe Werk

Suitable transport for everyone in Rotterdam

Thank you in advance for helping us in this project where we look at the mobility needs of the Dijkzigt and Nieuwe Werk neighbourhood! Your perspective is very important to gain a better understanding of the mobility needs and preferences of the people in Dijkzigt and Nieuwe Werk! Looking towards the future, we are looking for diverse insights to form a realistic picture of how people move or would like to move around our city. Your experiences and opinions will help us find solutions that can improve mobility for everyone.

The responses to this questionnaire are completely anonymous and will only be used for research purposes within this project.

What best describes why you are currently in the neighbourhood Dijkzigt/Nieuwe Werk? *

- I am a resident: I live here
- I am a visitor: I am here for a visit (e.g., for a hospital appointment, a day out, or visiting family)
- I am a commuter: I come here regularly (e.g., for work, study, school)

Resident of the Dijkzigt / Nieuwe Werk neighbourhood

As you indicated, you live in the Dijkzigt / Nieuwe Werk neighbourhood. Here are some questions for you as a resident.

What distances do you typically cover on an average day? *

Multiple answers possible.

- I stay in my neighbourhood (Dijkzigt/Nieuwe Werk)
- I go to another neighbourhood in the centre (e.g., to Cool)
- I go to another district/area in Rotterdam (e.g., to Prins Alexander)
- I leave the city (e.g., to The Hague)
- Anders: _____

What are the most common daily activities for which you go somewhere? *

Multiple answers possible.

- Going to work
- Going to school (elementary school/high school)
- Going to study (higher education/university/course)
- Going to the supermarket
- Going to the market
- Going to other stores for daily necessities
- Going to the park
- Exercising (gym, jogging, etc.)
- Visiting cafes, restaurants, and/or bars
- Cultural activities (theater, museums, cinema, etc.)
- Visiting family or friends/meeting up
- Going to the hospital or doctor
- Going to the physiotherapist/pharmacy or other medical appointments
- Going to a parcel point/post office
- Taking children to school or daycare and/or picking them up
- Taking children to sports/music lessons and/or picking them up
- Taking a family member or friend somewhere
- Walking the pet(s)
- Anders: _____

What type of transportation do you mostly use for everyday activities? *

Multiple answers possible.

- I walk
- I use my bicycle
- I use my electric bicycle
- I use my cargo bike
- I use my electric cargo bike
- I use my folding bike
- I use my Fatbike
- I use a shared bike
- I use an electric shared bike
- I use an electric shared cargo bike
- I use my scooter/moped (petrol)
- I use my electric scooter/moped
- I use my motorcycle
- I use a shared scooter/moped
- I use my car
- I use my electric car
- I use a shared car (petrol/diesel)
- I use an electric shared car
- I use a taxi
- I use the metro
- I use the tram
- I use the bus
- I use the train
- I use the water taxi
- I use my mobility scooter
- I use my micro car (e.g., Canta or Birò)
- I use my (electric) scooter
- Anders: _____

What is important to you when choosing what means of transport (car, bicycle, tram) or type of transport (shared, public or private) to use? *

Multiple answers possible.

- Cost
- Vehicle speed
- Travel time
- Frequent departure times
- Well-matching departure/arrival times
- High availability
- Reliability
- Comfort
- Minimal walking
- Not having to drive yourself
- Driving yourself
- Not too many transfers or switching between modes of transportation
- Flexibility
- Little or no maintenance
- Environmental impact
- Physical safety (e.g., vulnerability in accidents)
- Mental safety (e.g., fear of cycling alone at night)
- Physical accessibility (e.g., ease of getting in and out)
- Mental accessibility (e.g., easily understandable payment system)
- Previous positive experiences
- Previous negative experiences
- Social interaction with others
- Privacy (prefer to be alone)
- Ability to carry (a lot of) luggage
- Ability to travel together (with friends or family)
- Ability to bring a pet
- Whether it's trendy/hip
- Whether it appeals to others
- Whether it has some sort of status
- Anders: _____

How dependent are you on a car in your daily life? *

1 2 3 4 5

Not dependent at all: I could easily do my daily activities without a car.



Very dependent: I couldn't do my daily activities without a car.

Can you explain in what way you are dependent or not dependent on the car? *

Jouw antwoord _____

Would you say that you mainly make your transportation choices based on pros and cons, or mainly out of habit? *

- I consider the pros and cons of different options and choose what fits best
- I mostly choose out of habit

Do you sometimes feel that you are less mobile than you would like to be when you want to go somewhere? *

Multiple answers possible.

- Yes, due to aging
- Yes, because I don't have a driver's license
- Yes, because I lack necessary skills (e.g., inability to cycle)
- Yes, due to my physical or mental health
- No
- Anders: _____

If yes, in what ways do you mainly notice this, and how do you deal with it? *

Jouw antwoord _____

Do you experience problems with the current mobility options in the Dijkzigt/Nieuwe Werk neighbourhood? *

- Yes
- No
- Sometimes / a little

If yes, what problems and challenges do you encounter as a result? *

Jouw antwoord _____

Would you undertake more activities outside if you could reach them more easily? *

- Yes
- No
- I don't know

Would you be interested in new mobility solutions if they were available? *

- Yes
- No
- I don't know

When choosing and/or purchasing a mode of transportation, do you take the future into account? *

For example, that it will become increasingly difficult (and expensive) to park a car in the city, which makes a car less attractive

- Yes
- No
- Sometimes / a little

Do you ever worry about how travel in the city and your surroundings will change? *

- Yes
- No
- Sometimes / a little

Could you explain what concerns you? *

Jouw antwoord _____

Basic details

Finally, we would like to know some basic details from you

In which age category do you fall? *

- 0-15 years old
- 16-25 years old
- 26-45 years old
- 46-65 years old
- 65+ years old
- Prefer not to say

What is your gender? *

- Female
- Male
- Non-binary/non-conforming
- Prefer not to say
- Anders: _____

What is your living situation? *

- I live alone
- I live with my partner (we have no children)
- I live with my partner (the children have moved out)
- I live with my partner and child(ren)
- I am a single parent with child(ren)
- I live with my parent(s)
- I live with others (for example, with friends)
- I live in a care home
- Prefer not to say
- Anders: _____

What is the highest education level you have completed or the highest degree you have obtained? *

- Lower than highschool diploma
- Highschool diploma or equivalent
- College or university but no degree
- Bachelor's degree
- Master's degree
- Ph.D./Doctorate
- Prefer not to say
- Anders: _____

What is your background? *

- Dutch background
- Western migration background
- Non-western migration background
- Prefer not to say
- Anders: _____

Which of the following categories best describes your employment situation? *

- I have a job, working 1-39 hours per week
- I have a job, working 40 hours or more per week
- I am unemployed, actively looking for work
- I am unemployed, not looking for work
- I am a student or a pupil
- I am retired
- I am (currently) unable to work
- Prefer not to say
- Anders: _____

What is your personal monthly net income (the amount you receive per month)? *

- Less than €1000
- €1000 to €2500
- €2500 to €5000
- €5000 or more
- I don't know
- Prefer not to say

End of the survey

Would you be interested in making an additional contribution to this project through a brief (digital) interview? If so, you can leave your email address or phone number below, and we will get in touch with you!

Jouw antwoord _____

Do you have any comments?

Jouw antwoord _____

Appendix F: Interview questions

Resident focus

1. What does an average day look like for you? What are your daily activities, particularly the ones that require you to leave the house?
2. How do you get to these locations?
3. Why do you choose to travel to these places in this way (pros)?
4. What are the main drawbacks of the transportation methods you use (cons)?
5. Imagine that the transportation methods you currently use suddenly fail, break down, or become unusable in some other way. What alternative would you choose for each activity? Consider private transportation (car, bike, scooter, etc.), shared transportation (shared scooter, shared bike, shared cargo bike), and public transportation (bus, tram, metro, train).
6. Why would you choose that mode of transportation?

Commuter/visitor focus

1. Why are you here right now?
2. How did you get to this location?
3. Why did you choose to come here in this way (pros)?
4. Are there any drawbacks to coming here this way (cons)?
5. Imagine that it was suddenly not possible to use the transport method you used to come to this location (for example, due to a car that won't start, a flat bike tire, or a bus strike). How would you have come here? Consider private transportation (car, bike, scooter, etc.), shared transportation (shared scooter, shared bike, shared cargo bike), and public transportation (bus, tram, metro, train).
6. Why would you choose that mode of transportation?

Appendix G: Expert interview: team shared mobility Gemeente Rotterdam

The interviewee works part-time for Gemeente Rotterdam as a behaviour expert for shared mobility and as a project manager and designer for a neighbourhood approach to mobility. On behalf of Gemeente Rotterdam she conducted research to map the needs of future residents and users of M4H.

The interviewee developed a travel segmentation model for Gemeente Rotterdam and De Verkeersonderneming based on previous behavioural studies. This model helps to identify the driving forces behind people's mobility choices. Using the existing DiSC (Dominance, Influence, Steadiness, Conscientiousness) personality test (Figure G1), she created a model focusing on mobility. By conducting a survey among a group of people, she created a segmentation model based on personalities with a split-off on mobility, based on DiSC. This makes it possible to understand how people who are, for example, 'red' in a DiSC model think about mobility and what their priorities are. The model is based on 5000 people and she mentions that it is very accurate.

The DiSC analysis is a behavioural self-assessment tool that provides insight into people's behaviour and is based on a theory developed by American psychologist William Moulton Marston. In this theory, he suggests that human behaviour can be divided into four groups: 'Dominance', 'Influence', 'Steadiness', and 'Conscientiousness' (IPB Partners, n.d.). The test is mainly used for business purposes such as recruitment, selection and team creation. However, the theory is not widely supported by behavioural science (Costa & McCrae, 1992; Brennan & Prediger, 1981).

She then analysed the plans for M4H and identified that the future vision for the neighbourhood would appeal to people who are red and purple (between red and blue). However, Gemeente Rotterdam requires the area to have 20% social housing to create a mixed community. So she made a selection of people to represent the neighbourhood on paper; the intended colours combined with different income levels. She recruited people from surrounding neighbourhoods and neighbourhoods that she identified as comparable, such as Nieuwe Werk

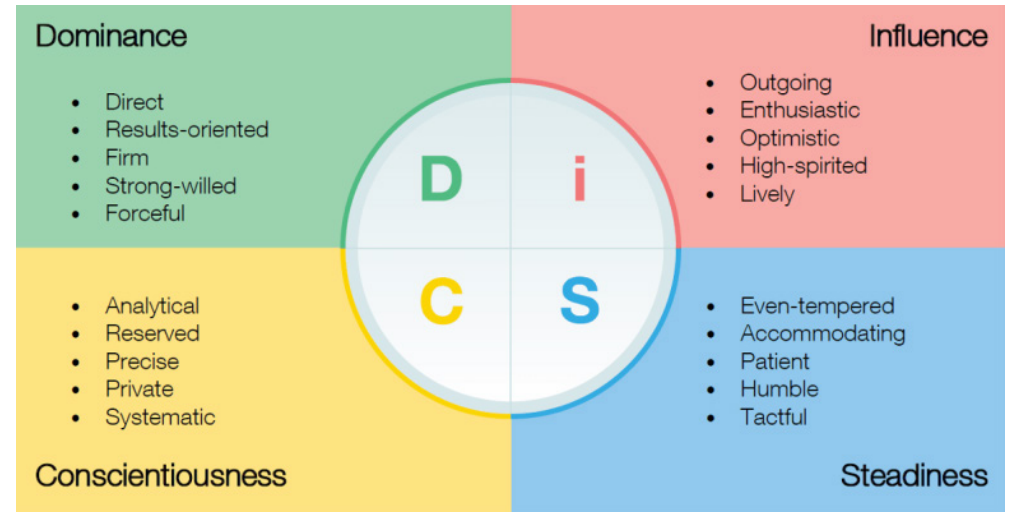


Figure G1: The DiSC model, showing the characteristics of each personality colour.

and Schiemond. These comparable neighbourhoods were identified through a combination of personality colours and postal code data. She then presented the plans to this group of people via interviews and gathered their needs and barriers to living in the area. Certain themes were explored:

- General mobility needs, what do you need?
- How many cars do you want on a car-free pier?
- When does it feel like a car-free pier and when does it not?
- What is acceptable for people? What distance is acceptable to walk?

Based on the model and interviews, she created several personas representing the people who fit the intended profiles.

The research suggested that everyone would ideally prefer the most car-free and innovative scenario, as it would create the most pleasant living environment. At the same time, people were very sceptical about the inclusiveness and feasibility of such a scenario. Can everyone really live here? Is it practical? There are indeed many exceptional situations and mental barriers. The advice that came out of this was that the plan should be executed radically, otherwise the concept would fail. This means that the piers must be radically car-free and green, with a strong strategy. It is also important that the offering in the hubs is excellent and that walking distances are short.

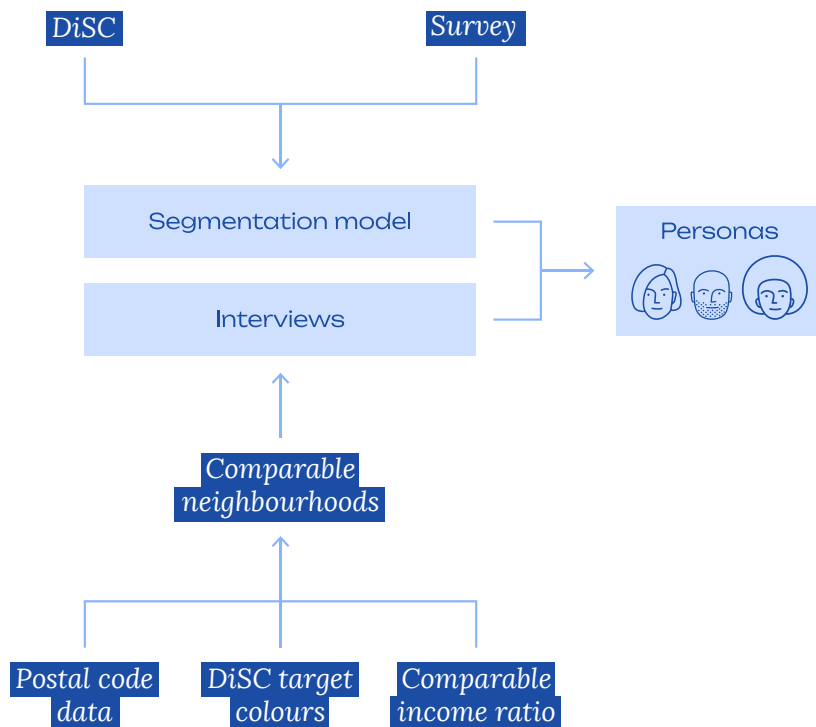


Figure G2: Schematic visualisation of the approach

Review and remarks of the approach

The results highlighted that there are still areas for improvement for the strategy of M4H in terms of inclusivity. This is a valuable insight to add to the more ambitious information gathered through the published reports. Relevant information from the other areas related to this theme will be applied to M4H.

Reviewing a similar approach is valuable and provides interesting differences and comparisons. In principle, the approach is quite similar, using existing data from other areas to estimate future users. However, the possibilities are much greater when having access to a lot of existing data.

I believe that in order to make a mobility strategy inclusive, it is important to focus specifically on this aspect, rather than only gathering a representative group for research. These groups need special attention and face challenges that may not be adequately highlighted by a representative sample in a research group and therefore may be overlooked. Furthermore, I think it is advisable to reconsider the use of the DiSC model. Firstly, it is an assumption to suggest that there is a correlation between a particular personality colour in the DiSC model and one's perspective on mobility; it cannot be directly assumed that everyone who is red thinks the same way about mobility. Besides that, there are also many doubts about the reliability and consistency of the test. The test oversimplifies human personality (Costa & McCrae, 1992), and people can give different answers when they take the test again (Brennan & Prediger, 1981). Different personality traits may emerge depending on the situation and context.

Appendix H: Expert Interview: Beer Pijpker (Fietsschool010)

Eight years ago, Beer Pijpker started with Fietsschool010. After a varied career filled with experimentation (including 'de Verkeersakademie', furniture making, teaching, working as a bicycle taxi driver, and serving as a city guide) Beer found the perfect combination of physical activity and social interaction: teaching cycling. He observed a gap in Rotterdam's offerings regarding cycling lessons and once he started, he quickly noticed the demand was extremely high. Currently, he works with about 10 people, but soon the Municipality of Rotterdam will take over through the community centres "Huizen van de Wijk", which will allow for scaling up the initiative. With all his experiences, Beer has gained valuable insights into the phenomenon of mobility poverty in Rotterdam. Some interesting quotes and anecdotes from the interview will follow below.

“Actually, it's always been a long-standing desire to learn to ride a bike. People often take about 5 years to finally take the plunge. That desire runs very deep.”

“A man of, let's say, around 60 years old, he worked in a three-shift system at a bakery in Spaanse Polder and lived in Bloemhof in Rotterdam Zuid. When you finish a night shift, especially on weekends, there's very little public transport available. He really wanted to just cycle home peacefully after such a workday. And he learned to do so. He fell during the first two lessons, resulting in a minor injury to his forehead. Then he started wearing a helmet, and the problem was solved. His son paid for it, which I found so touching. His son also helped him find out how and where he could learn to cycle.”

“That's the beauty of this profession; the moment they ride a bike for the first time, they scream out, "Huh?! I can do it!" And before that, it's just fear, fear, fear. It always reminds me of gym class when you first jump over the vault. You think it's way too high and it won't work at all. But with a good gym teacher, if you dare to take that leap, you fly right over it.”

“We always add as a side note that if the lesson fee of €10 is truly a barrier, please feel free to contact us, and we'll work together to find a solution. I've even given lessons for free.”

“I also once encountered a retired lady who couldn't maintain her balance anymore, which made her afraid to cycle, and she didn't want to resort to using a walker. She bought a tricycle, and I went for a ride with her twice, and after that, she could do it. Afterwards, she was overjoyed to feel free again to come and go as she pleased. And that's the common denominator, really; they want to be free.”

“You really have to think of the term "cycling happiness". When I first heard it, I thought, aren't we exaggerating a bit? But no, it's true. The feeling when you hop on your bike on a Sunday morning, not entirely sure where you want to go, and then you veer off a bit, and then a bit more. That's when you end up in places you'd never otherwise visit. That's the ultimate feeling of freedom and living.”

“ And then they immediately smile at the thought that they no longer have to lug around those shopping bags. ”

“ Maria was the only true born and raised ‘Rotterdammer’, aged over 50. She lived 3 km from her workplace. And on a sunny day, leaving work to get back into that car was not enjoyable. Seeing her colleagues happily cycling with their coats in their bicycle bags through the beautiful weather, she said, “I want that too.” ”

“ Mom is going to teach here at the university, and her two daughters, aged 15/16, come along and attend the bilingual school here. They also want to learn to cycle. Those girls obviously learn very quickly. But they were already looking forward to being able to cycle to school instead of taking the school bus when they returned to the US. ”

“ Once, there was a woman from Rotterdam Zuid, she was a refugee from Rwanda. During the third lesson, she had a fall and sprained her ankle badly. She said she would call back to resume the lessons once she recovered, but then she called to say she was pregnant, so it had to be postponed again. After her pregnancy, we resumed. She was very busy with her children, so I kept going to Rotterdam Zuid, she really deserved that. 1.5 years later, I received a photo, her second child was born. The first child was on the back and the second child was on the front, with the caption: “Now I am a pro!” ”

“ I also provide tricycle cycling lessons, which are becoming increasingly popular with the ageing population. As people age, their reaction times decline, and their hearing and vision deteriorate, leading to feelings of insecurity. I’ve truly felt the most gratitude from the elderly. Riding a tricycle is wonderful because you don’t need to maintain balance, and you can ride at your own pace. It’s very rewarding to work with elderly individuals. They have so much life experience; you just have to find the right balance of relaxation and challenge. But they simply have the desire to be able to go to the supermarket at the very least. They want independence. ”

Appendix I: Data inputs for labelling (thematic analysis)

For Dijkzigt/Nieuwe Werk and Feijenoord, these include:

- Interviews with travellers
- Survey responses
- Observations
- Expert interview with Beer Pijpker from Fietsschool010 (mostly relevant for Feijenoord)
- Results from the Omnibusenquête mobiliteit (Gemeente Rotterdam, 2023c)
- News article (Schreuder, 2024) (relevant for Dijkzigt/Nieuwe Werk)

For M4H these include:

- Expert interview with someone from 'Team shared mobility' Gemeente Rotterdam
- Relevant reusable data from the research in Dijkzigt/Nieuwe Werk and Feijenoord
- Report: Ruimtelijk Raamwerk (Gemeente Rotterdam et al., 2019)
- Report: Toekomstbeeld bedrijvigheid M4H (Gemeente Rotterdam & Havenbedrijf Rotterdam N.V., 2022)
- Report: Masterplan Merwehaven (Gemeente Rotterdam, 2023a)
- Report: Mobiliteitsstrategie (Gemeente Rotterdam et al., 2022)
- Report: Rondetafelgesprekken (Gemeente Rotterdam, Havenbedrijf Rotterdam, et al., 2022)
- News article (Van Noort, 2024)

Appendix J: Sub-themes

Dijkzigt/Nieuwe Werk

- Comfort
- Businesslike
- High disposable income
- Visually appealing environment
- Conscious decisions
- Freedom (of choice)
- Status
- Congested/crowded traffic (practical)
- Crowded traffic (dangerous)
- Travelling as an activity
- Less time-bound
- Ignorance of options
- Physical disabilities
- Flexibility
- Reliability
- Travelling together
- Interest in innovative mobility
- Poor (evening/night) PT network
- Shared mobility as an exception
- Efficiency
- Inaccessibility of (remote) destinations

Feijenoord

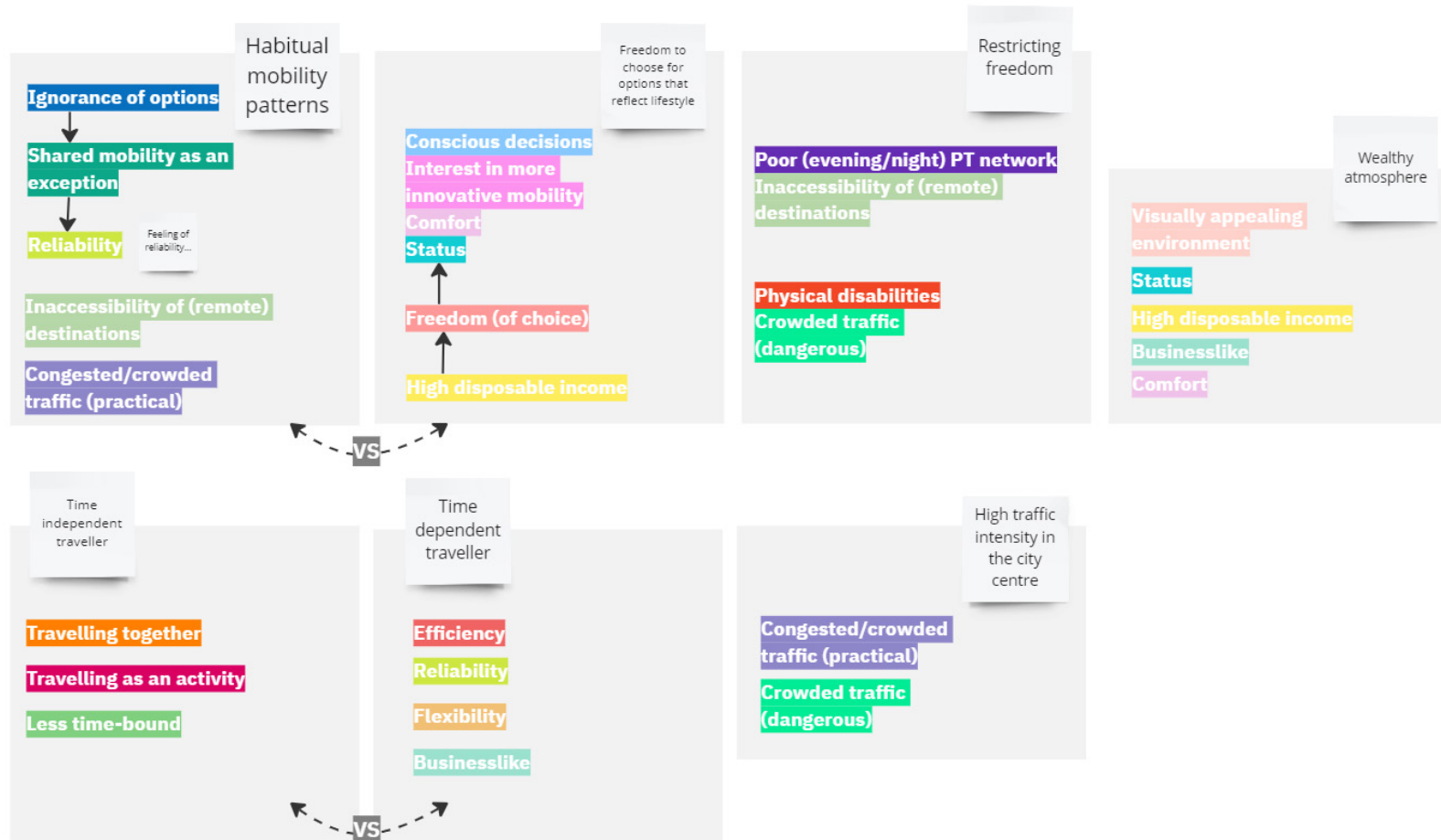
- No busy days
- Physical disabilities
- Low disposable income
- Everything is close by
- Nostalgic to a better life
- Desire for mobility freedom
- Reluctant (to share information)
- Don't complain, just do it
- Social
- Strong bond with family and friends
- Less mobile developed / mobility poverty
- Isolated area / few PT options
- Fairly rundown area
- Criticism of other traffic participants
- Criticism of infrastructure
- Aversion to the PT
- Walking and cycling is good for you
- Bring stuff/luggage
- Yuppies taking over?

M4H

- History as a port area
- innovative character
- Innovation based
- Dynamic mix of companies / industry
- Sharing and collaborating
- Mix of different price segments
- Knowledge Exchange
- Companies / industry
- Friendly character
- Initiative and engagement
- Social bonding
- Combining functions
- Uncommercial
- Vibrant atmosphere
- Flexibility
- Socially unsafe environment
- Too good to be true
- Accessibility
- Amount of facilities
- Inclusiveness
 - Low disposable income
 - No busy days
 - Nostalgic to a better life
 - Limited possibilities
 - Physical disabilities
 - Desire for mobility freedom
 - Less mobile developed
 - Don't complain, just do it
 - Walking and cycling is good for you

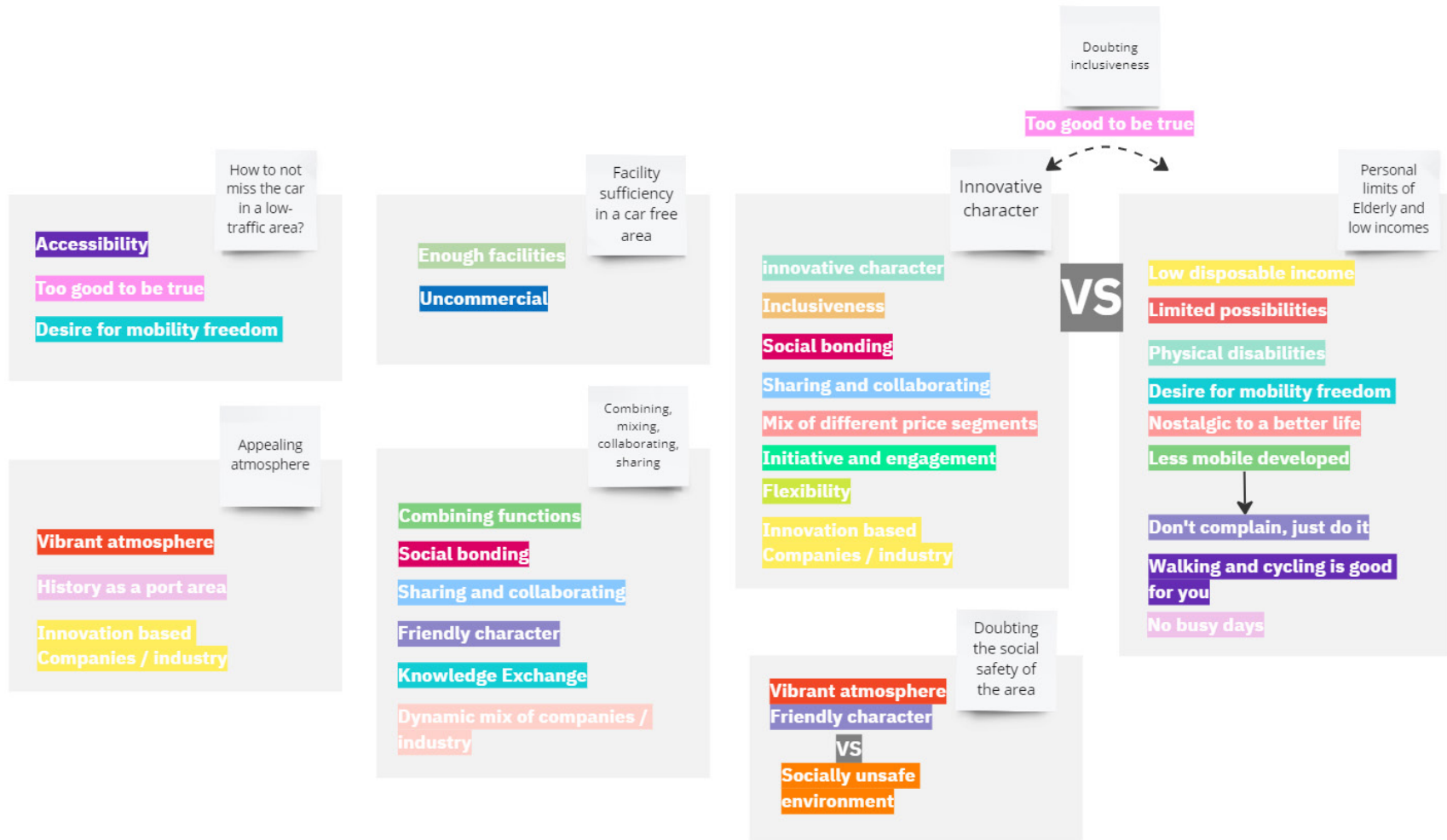
Appendix K: Main-themes (final clusters)

Dijkzigt/Nieuwe Werk



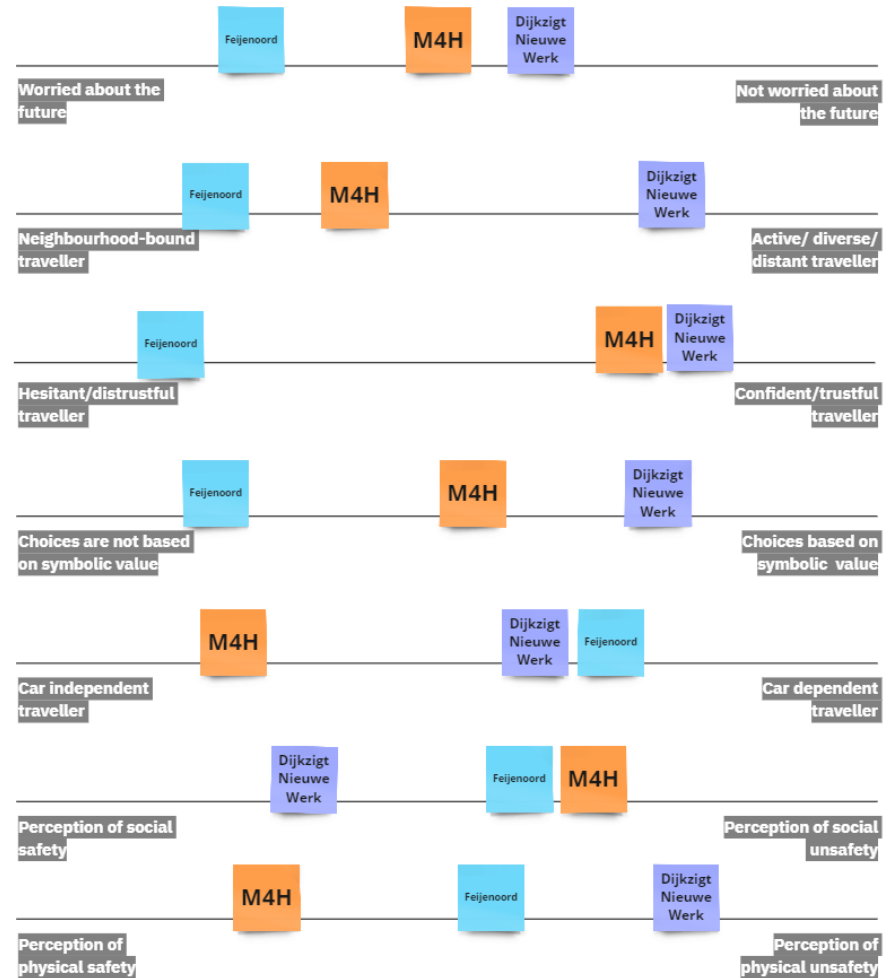
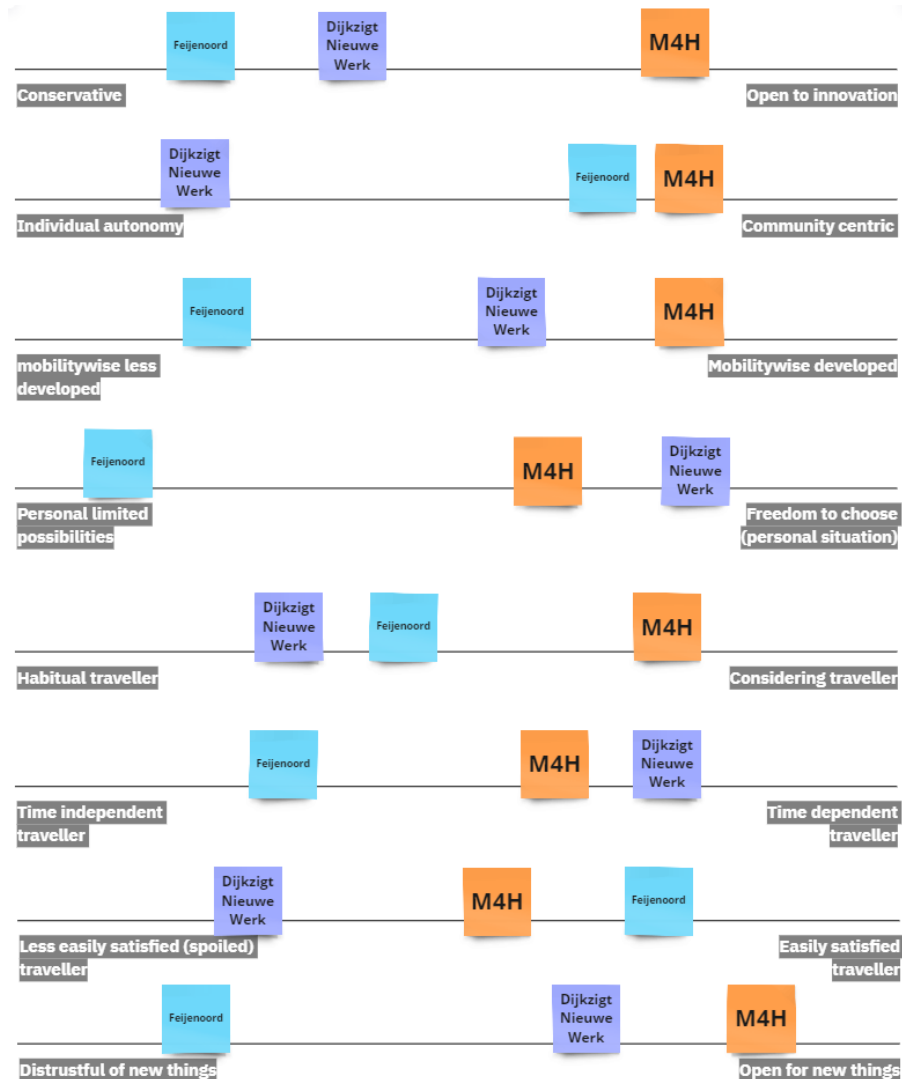
Feijenoord



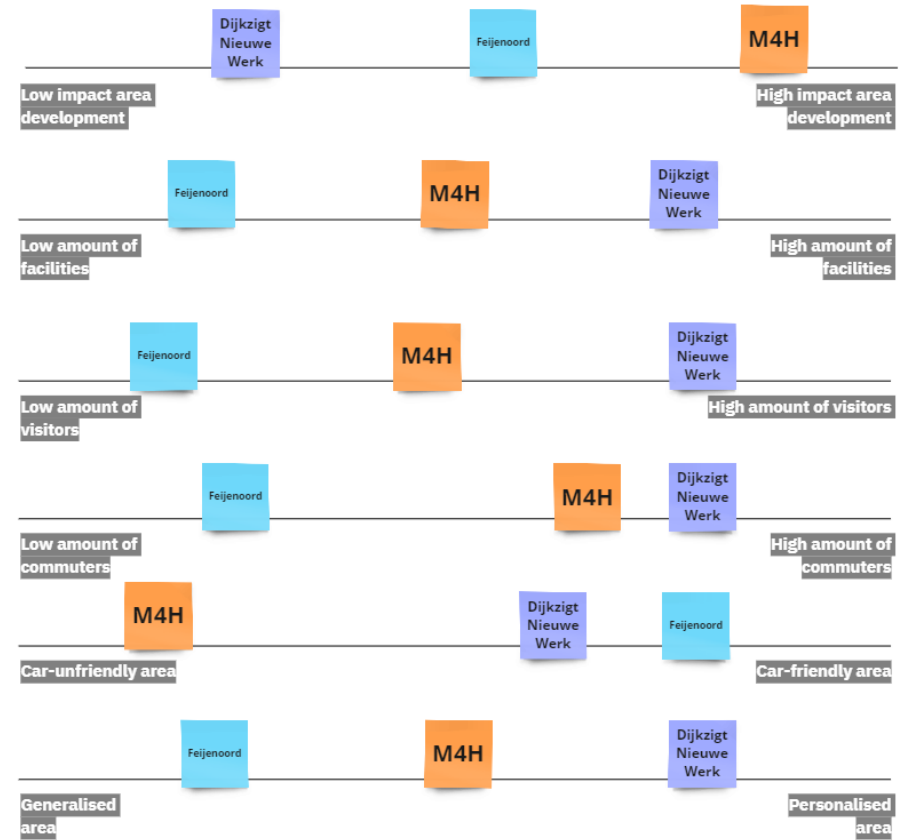
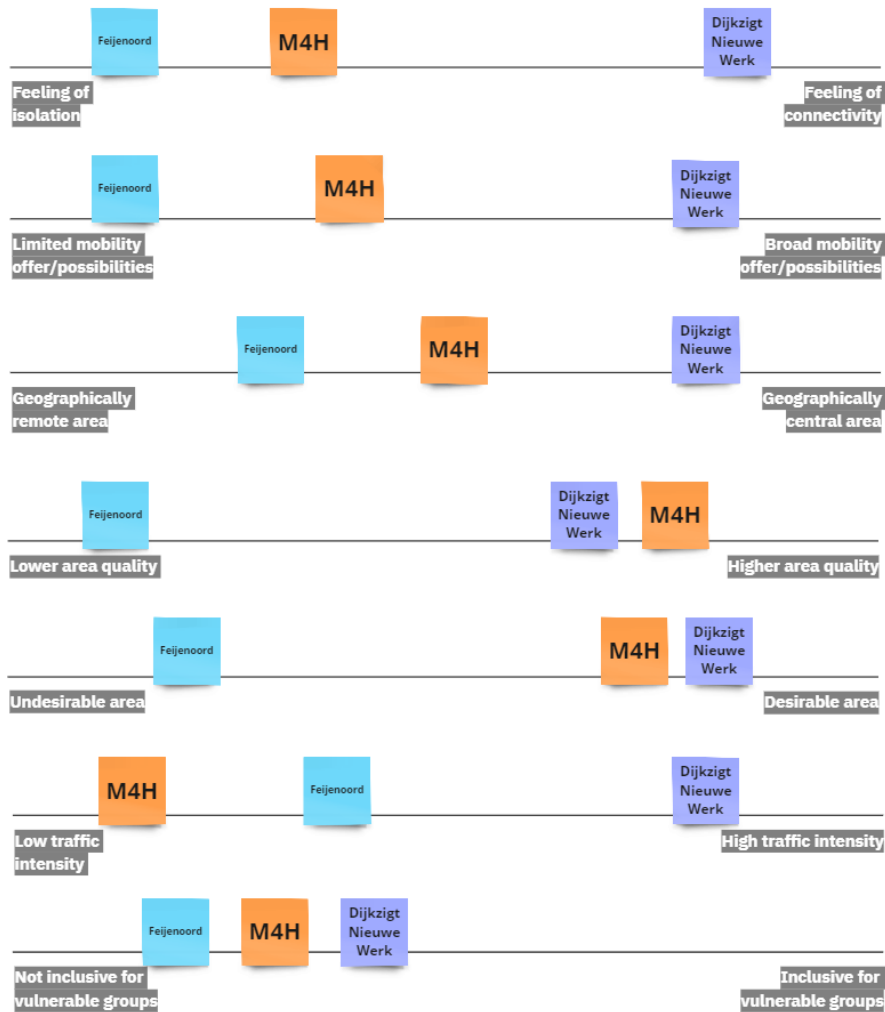


Appendix L: Scales

Personal factors (people related)

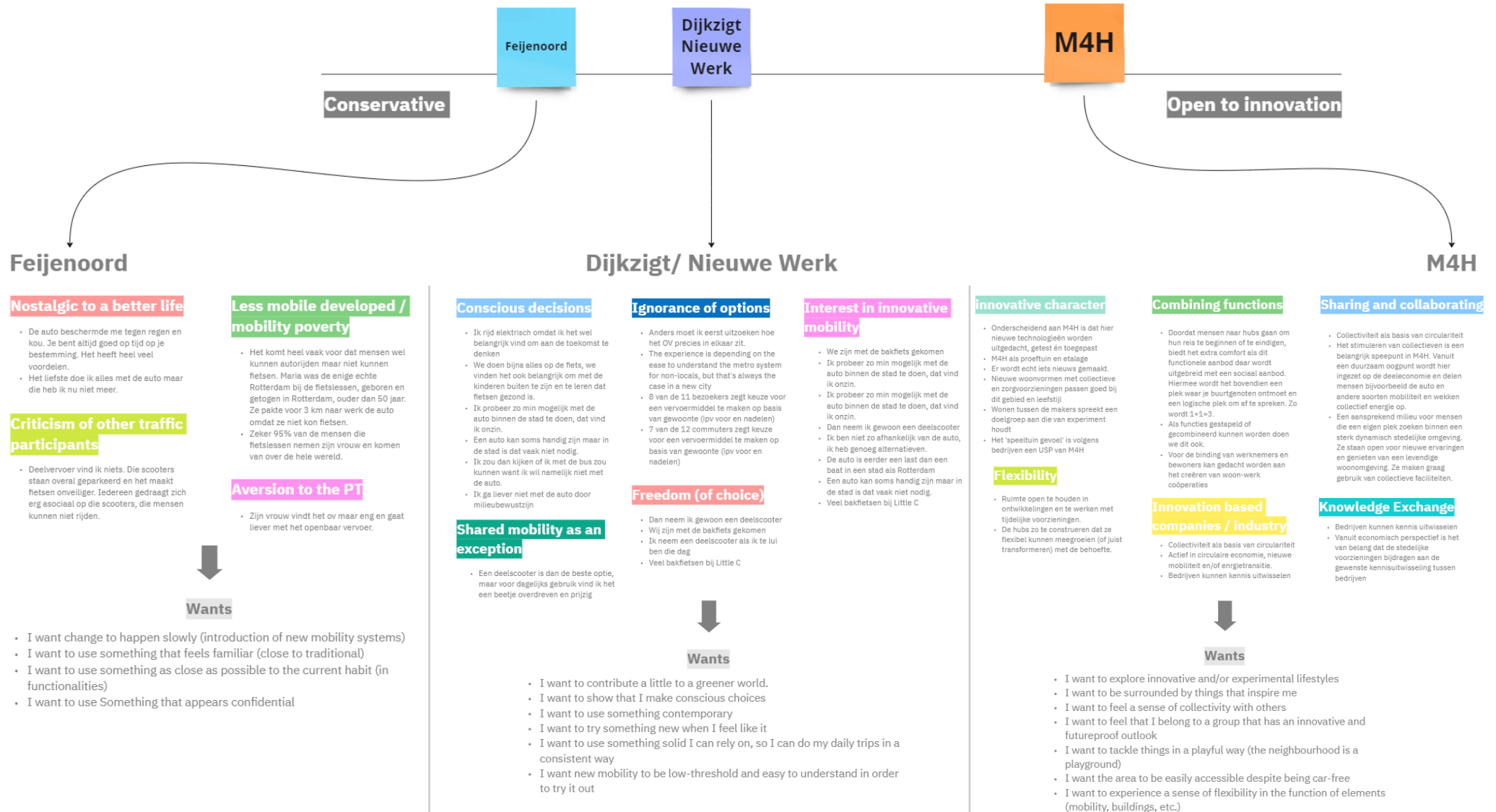


External factors (area related)



Appendix M: Scales to wants

To illustrate the translation from scale position to wants, an example of the procedure for one scale is shown.



Appendix N: Survey similarities Dijkzigt/ Nieuwe Werk and Feijenoord

Common activities

- Visiting friends and family
- Going to the supermarket
- Going to other stores for daily necessities
- Visiting cafes, restaurants and/or bars
- Exercising
- Cultural activities
- Going to work
- Going to the hospital, doctor, or other medical appointments

Common types of transportation

- Walking
- Bicycle
- Car
- Metro
- Train

Mobility related values

- Travel time
- Cost
- Well-matching departure/arrival times
- Minimal walking
- Not too many transfers or switching between modes of transportation

Problems

- Poor connection in the evenings and weekend
- Public transport is far to walk from home

Interest in new mobility solutions

- Most people are interested in new mobility solutions if they were available.

Concerns

- Less public transport (changes, cuts in public transport, disappearance of lines)
- What kind of impact will the big mobility changes in the city have on me personally? e.g. a new bridge, Feijenoord city, a car-free city centre? Everyone feels that change is coming but it's unclear when, what, and the actual impact..

Appendix O: Rotterdammers characteristics

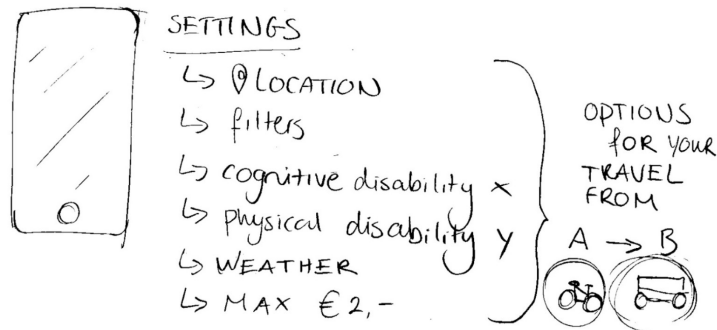
- *Rough*: Rotterdammers can sometimes be rough and tough, and therefore sometimes slightly unpleasant.
- *Real*: genuine, with character, and honest. Rotterdammers do not pretend to be better than others.
- *Direct*: without postponing, doing things immediately. But also being straightforward.
- *Honest*: open, speaks his mind.
- *Loyal*: steadfast, persevering and dutiful.
- *Modern*: not only for the praised architecture, but also for the diversity of its people.
- *Hardworking*: roll up your sleeves attitude. “Niet lullen maar poetsen” (actions speak louder than words).
- *Foreign roots*: Many nationalities, a global port and many multinational companies.
- *Daring*: Have courage. Gemeente Rotterdam Rotterdam once used the slogan: “Rotterdam durft!” (Rotterdam dares!).
- *The Rotterdam approach*: Rotterdam is made by Rotterdammers. Many Rotterdammers are committed to improving the city.



Appendix P: Other concept ideas

1. Mobility recommendation in app

- Gives personalised mobility solutions based on: location, preferences, limitations, weather, etc.



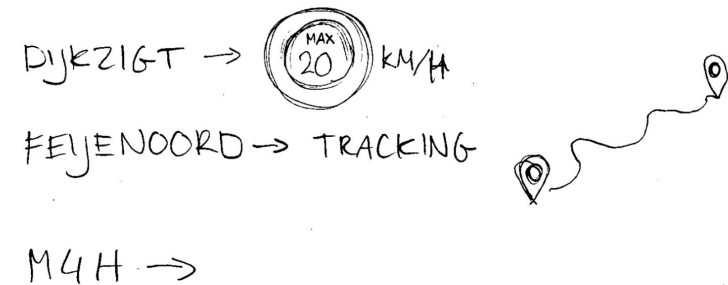
2. Mobility recommendation physical

- Physically in the Huizen van de Wijk (or by phone)
- Assistance by recommending the most suitable mobility solution



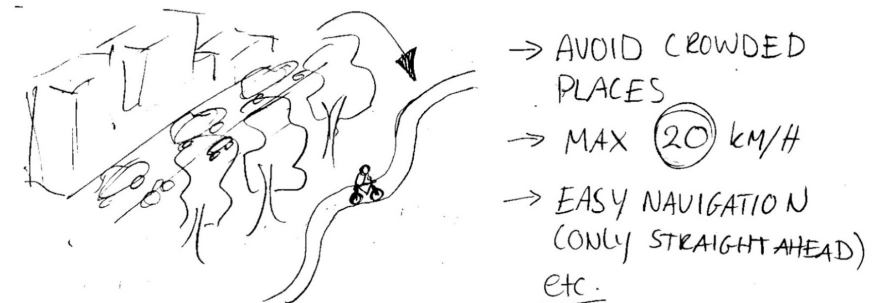
3. Extra features based on location or preferences

- For example, speed limit intervention on scooters/e-bikes, or a tracker on a friend's/family member's vehicle for safety.



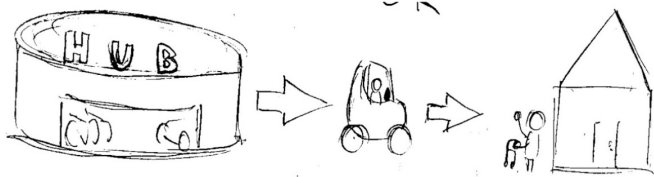
4. Route generator

- Based on preferences
- For example, avoiding busy streets using real-time traffic data



5. Door-to-door service

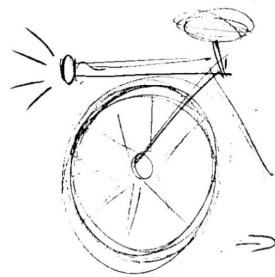
- Mobility solutions come to you, instead of you going to a hub



- FOR PEOPLE WHO HAVE DIFFICULTY WALKING
- MAKES IT MORE LOW-THRESHOLD TO USE SHARED MOBILITY FOR VULNERABLE GROUPS

6. Colour codes

- Coloured LEDs on vehicles
- For example: blue = first timer, yellow = elderly, green = tourist

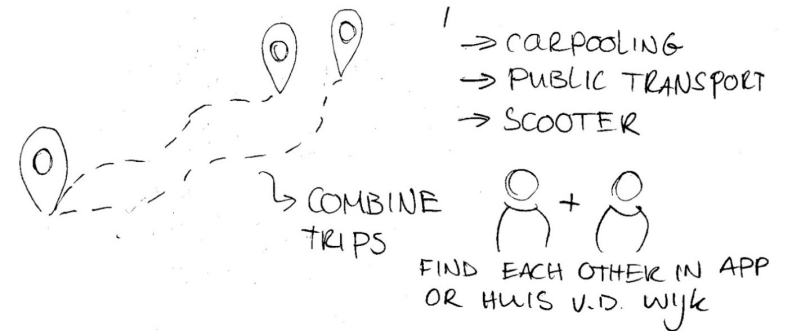


BLUE = FIRST TIMER
 RED = EMC PATIENT
 YELLOW = ELDERLY
 GREEN = TOURIST

→ TO BE CONSIDERATE OF OTHER ROAD USERS

7. Travel community

- Sharing rides with each other
- Assist each other in using public transport



8. Neighbourhood collective

- Shared responsibility for some vehicles
- Subsidised for eligible neighbourhoods

RECEIVE (?) SOME TRANSPORTATION MODES
 → BIKES, E-BIKE, SCOOTER, MOBILITY SCOOTER ETC.

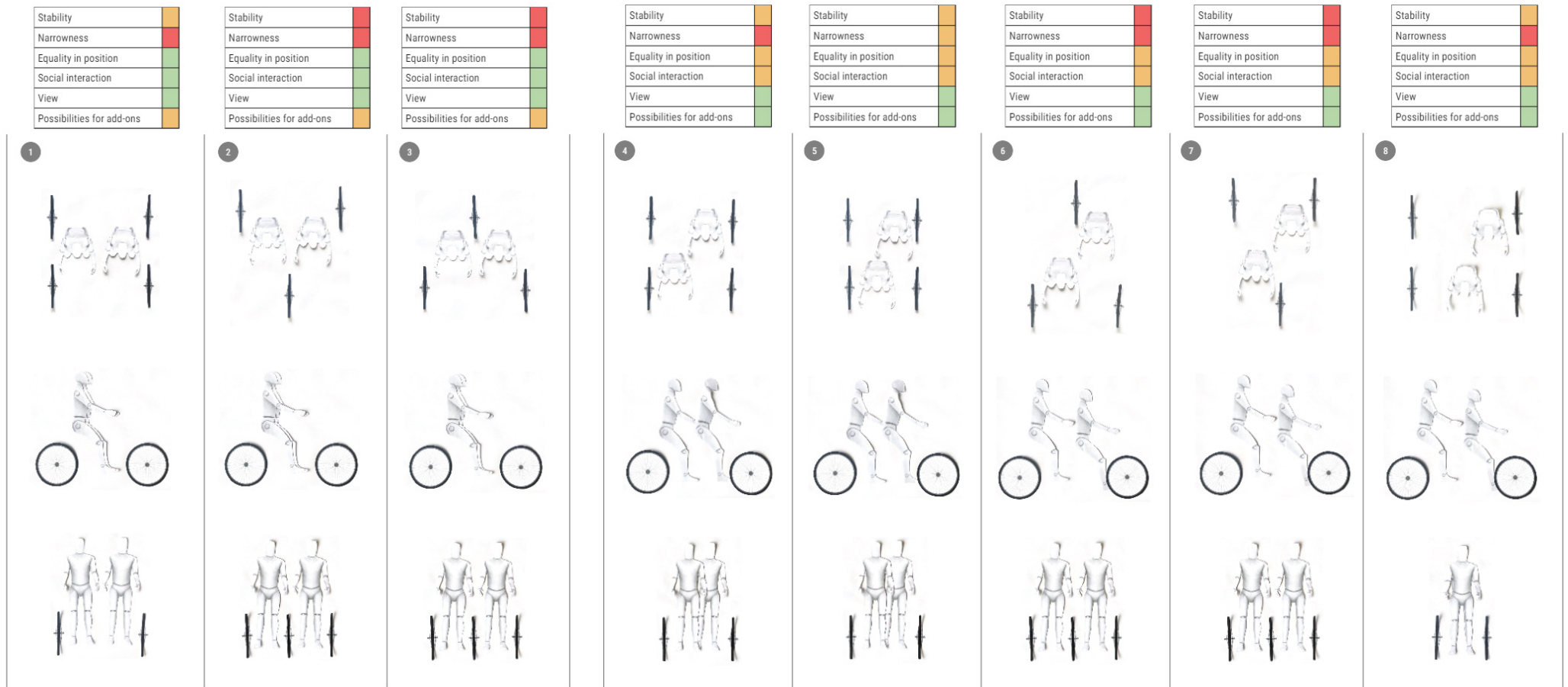


SHARED PRIVATI RESPONSIBILITY

Appendix Q: Concept rating

	Solution for all three areas	Effectiveness	Element of generalisation	Diversity in vulnerable groups	Potential for Louwman	Notes
Mobility recommendation in app	Green	Red	Green	Orange	Orange	Not usable for (digitally illiterate). Gives insights only, not extra possibilities.
Mobility recommendation physical	Green	Red	Green	Green	Orange	Gives insights only, doubting how insightful this would be for users.
Extra features based on location or preferences	Red	Red	Green	Orange	Green	Could be a nice addition to current solutions, but not so much effective ideas for features
Stable bicycle	Green	Green	Green	Orange	Green	A smart idea to make it affordable would make it also interesting for low incomes.
Route generator	Orange	Red	Green	Red	Red	Doubting the effectiveness, only makes a small difference in just a few cases
Door-to-door service	Red	Orange	Orange	Orange	Green	Only interesting for people with disabilities
Colour codes	Green	Orange	Green	Orange	Green	Could be an addition to current mobility solutions. serves a variety of modalities.
Travel community	Orange	Orange	Green	Orange	Orange	Interesting idea but Louwman only facilitates the match, not that interesting
Neighbourhood collective	Green	Green	Orange	Green	Orange	Not viable. Contribution of the Gemeente?

Appendix S: Bicycle configurations and rating



Stability	Green
Narrowness	Green
Equality in position	Orange
Social interaction	Red
View	Orange
Possibilities for add-ons	Green

Stability	Orange
Narrowness	Orange
Equality in position	Orange
Social interaction	Orange
View	Orange
Possibilities for add-ons	Green

Stability	Orange
Narrowness	Green
Equality in position	Orange
Social interaction	Red
View	Orange
Possibilities for add-ons	Green

Stability	Orange
Narrowness	Green
Equality in position	Orange
Social interaction	Red
View	Orange
Possibilities for add-ons	Green

Stability	Green
Narrowness	Green
Equality in position	Orange
Social interaction	Orange
View	Orange
Possibilities for add-ons	Green

Stability	Green
Narrowness	Green
Equality in position	Orange
Social interaction	Orange
View	Green
Possibilities for add-ons	Green

Stability	Orange
Narrowness	Green
Equality in position	Orange
Social interaction	Orange
View	Orange
Possibilities for add-ons	Green

Stability	Orange
Narrowness	Green
Equality in position	Orange
Social interaction	Orange
View	Orange
Possibilities for add-ons	Green

9



10



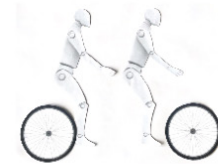
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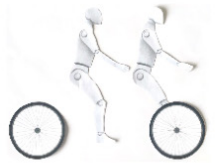
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16



Appendix T: Project brief



Personal Project Brief – IDE Master Graduation Project

Name student Arabella van Lookeren Campagne Student number _____

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Designing for a future urban mobility system: Targeting inclusivity as a commonality in three Rotterdam neighbourhoods

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

Rotterdam stands out among Dutch cities for its strong emphasis on automobiles. After the 1940 bombing, the city was rebuilt along the lines of American cities where the automobile was central, and where living, working and recreation were separated.

Growing urban populations, increasing traffic congestion and the need to use more sustainable transport solutions are forcing cities to think about the future of mobility. This centres on seamless, efficient and environmentally friendly transport systems that improve the traveller's user experience.

Rotterdam is currently undergoing a mobility transition in which the car is playing an increasingly less prominent role. More space will be given to pedestrians, cyclists, public transport or other sustainable means of transportation (Gemeente Rotterdam, 2021).

Mobility hubs are an essential part of this transition. This is where various modes of transport come together for a seamless travel experience. Besides forms of mobility, a hub is a suitable medium to set up mobility in a broader sense, where other functionalities can smartly integrate.

This transition is also strongly noticeable at Louwman Group, which started 100 years ago as a Dutch importer of American automobiles. Nowadays, Louwman is transforming into an organization where the definition of mobility extends beyond the automobile, following the pledge: 'Mobility for Life'. Within this transformation falls the interest in exploring inner-city mobility hubs with a focus on micromobility.

→ space available for images / figures on next page



Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice. (max 200 words)

Louwman Group would like to have a better understanding of people's motives concerning their mobility patterns. Which means of transportation is suitable for which need/want, target group, or situation? At the moment, Louwman's investment decisions are mainly made businesswise, with a focus on the company/product's growth potential. However, not enough attention is paid to the corresponding purpose of use and user group. An analysis of different areas in Rotterdam related to fitting mobility could help Louwman offer a more complete portfolio targeting a greater diversity of needs and wants. The context of the city of Rotterdam is well suited for an analysis of mobility needs and wants due to its huge diversity in neighbourhoods, population composition, culture, urban layout, infrastructure, activities, and types of travellers. This diversity leads to interesting contrasts within the same city when it comes to mobility needs and wants.

A great diversity in mobility needs and wants may result in a multitude of mobility solutions, which could be less space-efficient, lack on sustainability level, be confusing for users, and can significantly escalate costs. Modular mobility could be an interesting solution to those problems. Which elements overlap in different mobility solutions and could perhaps be combined? How can multiple needs and wants be covered with similar mobility solutions?

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Design multimodal touchpoints for future urban mobility hubs in three contrasting areas in Rotterdam, including an initial concept based on overlapping elements of the three areas.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

This approach is based on an interplay of zooming-in and -out between 'city level' and specific 'area level'.

- City level: Roughly analyse Rotterdam as a whole to pinpoint interesting contrasting areas.
 - Existing analysis/papers
 - Data of the municipality of Rotterdam
- Area level: Analyse three individual areas.
 - Collect data with e.g. interviews, observations, surveys, existing data.
 - Cluster data to specific needs and wants
 - Link to mobility with brainstorming and ideation sessions
- City level: Compare the needs and wants of all three areas and discover overlapping elements
 - Discover which needs and wants can be combined with similar mobility solutions (brainstorming and ideation sessions).
- City/Area level: Design a (modular mobility) concept
 - Apply to different needs and wants of multiple areas with different configurations.

Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting, mid-term evaluation meeting, green light meeting and graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting 21/11/2023

Mid-term evaluation 23/01/2024

Green light meeting 22/04/2024

Graduation ceremony 11/06/2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	<input type="checkbox"/>
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

In contrast to the classic IPD designer, I prefer to step a bit earlier in the process. I prefer delving into problem definitions, user research, requirements and wishes of relevant stakeholders, and subsequently generating a concept with functionalities that align as closely as possible with this.

I'm particularly captivated by thoughtful new alternative modes of transportation designed with a future focus. My primary interest lies in urban mobility which involves topics like expanding cities, limited space, and the urban transitions we are currently facing. With this project, I would like to increase my knowledge of future-proof (micro)mobility. This domain is currently a hot topic with lots of new innovations, but what is truly relevant?

During this project, I would like to translate the diverse needs of different individuals into practical features within a product. In a city as multifaceted as Rotterdam, the possibilities for analysing (mobility) needs seem endless. Therefore, I would like to develop the skill of efficiently gathering data while critically analysing what information is relevant.

Besides that, professionally visualising an initial concept that carries a persuasive impact, is a skill that I would like to improve and take with me in my future career. Within this project, the elaboration of the concept does not take the most prominent role, so it will be an interesting challenge to do this in an efficient yet effective way.

