Get inspired

A MaaS journey planner sparking travellers with endless personalised travel possibilities

Graduation report, September 2021

Seamless Personal Mobility Lab

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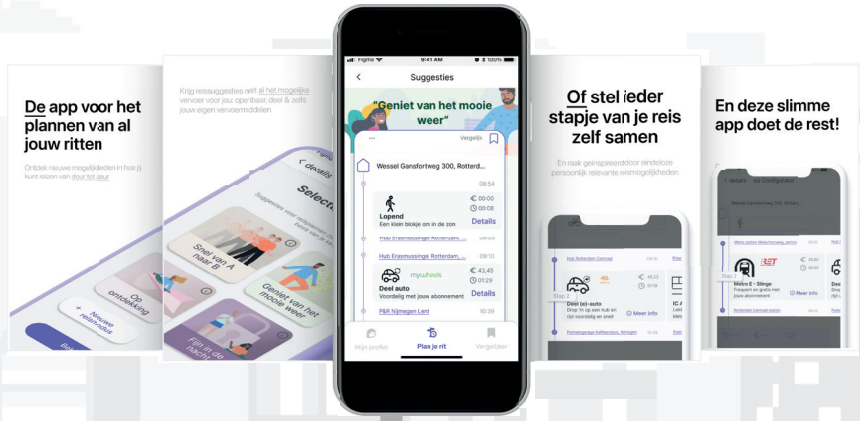

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Preface

The “everydayness” of mobility has always interested me highly. Everyone can relate to it. It is visible to everyone in society. Mobility opens worlds but can also close them... Self-driving and electric vehicles, MaaS developments, and smart transport: it offers enormous, innovative opportunities, but also social and operational challenges.

Parallel to starting my master Design for Interaction in 2018, I worked as a UX designer at the shared electric mobility service called Amber Mobility. During my work, I came in contact with the concept of MaaS by contributing to a pitch for one of the MaaS pilots initiated by the Dutch government. Nowadays, developments within MaaS in the Netherlands are already a lot further, therefore I felt a graduation project within MaaS would be an interesting way to close off my educational career.

Throughout the past six months I was given the opportunity to collaborate with both 9292 as RET. Two well-established companies that were both right in the middle of Mobility as a Service developments. I would like to pay my special regards to Suzanne for supporting me with setting up this collaboration in the first place. Besides, your knowledge and expertise of the mobility sector and your pleasant collaboration served great value throughout my graduation journey.

Next, I would like to express my thanks to Gert, for his listening ear and sharp questions. These really helped me to get my goals and activities aligned.

I would like to thank both 9292 and RET for providing me this chance, and for involving me in other processes and developments as well. Especially Tania and José I am extremely grateful for supporting me. Without your kindness, openness and interesting discussions this project had not been as successful.

Within my projects, I like to ‘create simple designs and put them in the world’ and conduct research to gain in-depth insights by involving potential users as early on in the process as possible. Throughout these activities often I got comments the presented prototype was far from finished and some even expressed it to be rubbish. But especially that I enjoy: asking what makes the design so bad, and facilitating in co-creating solutions for solving those issues is where my strengths are. I feel this high level of user engagement was crucial for the process. Therefore, I would like to thank all participants that took part in the various user tests and user research activities.

Furthermore, I would like to thank all friends and family that listened to my stories and discussions, for helping me proofreading and ensured taking my mind off the project and unwind.

And last but not least, I would like to express my deepest gratitude to Mike for his support throughout. Even though you expressed with pride in ‘how little stressed I was’, I know certainly for the last few weeks I seek greater support from you. During this graduation project in ‘Corona times’ we had to spend a great deal of time together. You were my colleague, brainstorm partner and co-parent in raising our puppy and I am proud how we dealt with these situations. But to be honest, I feel the mobility theme of this project elevated your enthusiasm and interest for helping me.

Happy reading,

Sara

Executive summary

Background
With increasing populations, the need for transportation is increasing as well. This creates societal issues putting pressure on the affordability of transport, the liveability of cities and sustainability of mobility infrastructure. The radical innovation that could potentially reform the entire transport system in order to tackle these societal challenges is Mobility as a Service. But for MaaS to become a succes, the current way the Dutch mobility system functions has to change, and travellers need to adopt the use of the system in a way that societal issues will actually be solved.

Whereas current developments regarding MaaS in the Netherlands are mainly focussed on creating a base on technical and policy level, this graduation project puts the individual traveller central. The project evolved around the process of designing of a mobile MaaS journey plan application that supports travellers with tailor-made travel advice to fulfil trip-dependent needs, when preparing a door-to-door travel plan. As a case study, the target group entailed travellers that travel to incidental leisure activities and live in an urban area with a large mobility offer (like Rotterdam). Along the line of a user-centred double diamond process, a variety of research activities and multiple design iterations are conducted with extensive user involvement to unravel true user needs and creating desirable and usable experiences. Based on the insights gained, a design of a mobile journey planner MaaS application is envisioned, prototyped and evaluated with travellers, mobility, design and technology experts.

For MaaS to become a success, the service should provide added value for travellers to adopt the service and stimulate a positive travel behaviour change. Currently the way people travel is very much rooted in existing habits and routines. Cross-checking multiple application is carried out in search of finding the best travel plan fulfilling travellers' specific travel needs. To improve the current process of planning a trip, the final design is focussed around supporting travellers in their information search on travel possibilities and evaluation of these alternatives.

Design criteria for creating a personally relevant travel plan
The process of creating a door-to-door travel plan should provide travellers with freedom of control and choice, speed and ease. Besides to create a window of opportunity for positive travel behaviour change, the design should provide personally relevant inspiration on a diversity of travel modes and allow for a clear comparison on different modes on each leg of the trip as well as for travels plans as a whole.

Get inspired – a MaaS journey planner
The final design is a journey planner sparking travellers with endless personalised travel possibilities. In the form of a white-label app, this design is envisioned being part of a MaaS application that supports travellers in their search for information and evaluation of possible travel modes and routes. The app provides travellers with two methods to create a door-to-door travel plan. The Reismodus method provides a few complete travel plans filtered by a personally chosen travel mode. On the other hand, travellers are provided with full control by the ability to compose the entire travel plan from scratch. On top of that, creating a profile and adding personal transport modes, subscriptions and/or discount cards, allows for evaluating the data that are truly apply to oneself.

Evaluating on desirability, viability, feasibility and integrity
The final design is evaluated with travellers, and design, technology and mobility experts on desirability, feasibility, viability and integrity. Conducting different guerrilla tests provided insights in the desire for an 'advanced profile' to support receive personally relevant travel suggestions and information, and a clear division of 'Reismodus advocates' and 'Stel samen advocates'. Besides the different functionalities of the final design are provided an initial estimation on the level of complexity, and are reviewed by design experts on usability and UX patterns. Eventually a variety of evaluation sessions with mobility experts generated insights in the design's strengths and weaknesses, as well as potential opportunities and threats.

List of abbreviations and definitions

IenW

Ministerie van Infrastructuur en Waterstaat
(ministry of Infrastructure and Water management)

Legs of the trip

Different steps of a multimodal journey

MaaS

Mobility as a Service

'New' travel services
Mobility offerings that are relatively new to the market, commonly offering a mobility service

PT

Public transport

Travel need-group
A target group based on specific needs for travelling

Wireflow
A combination of a use flow and a wireframe

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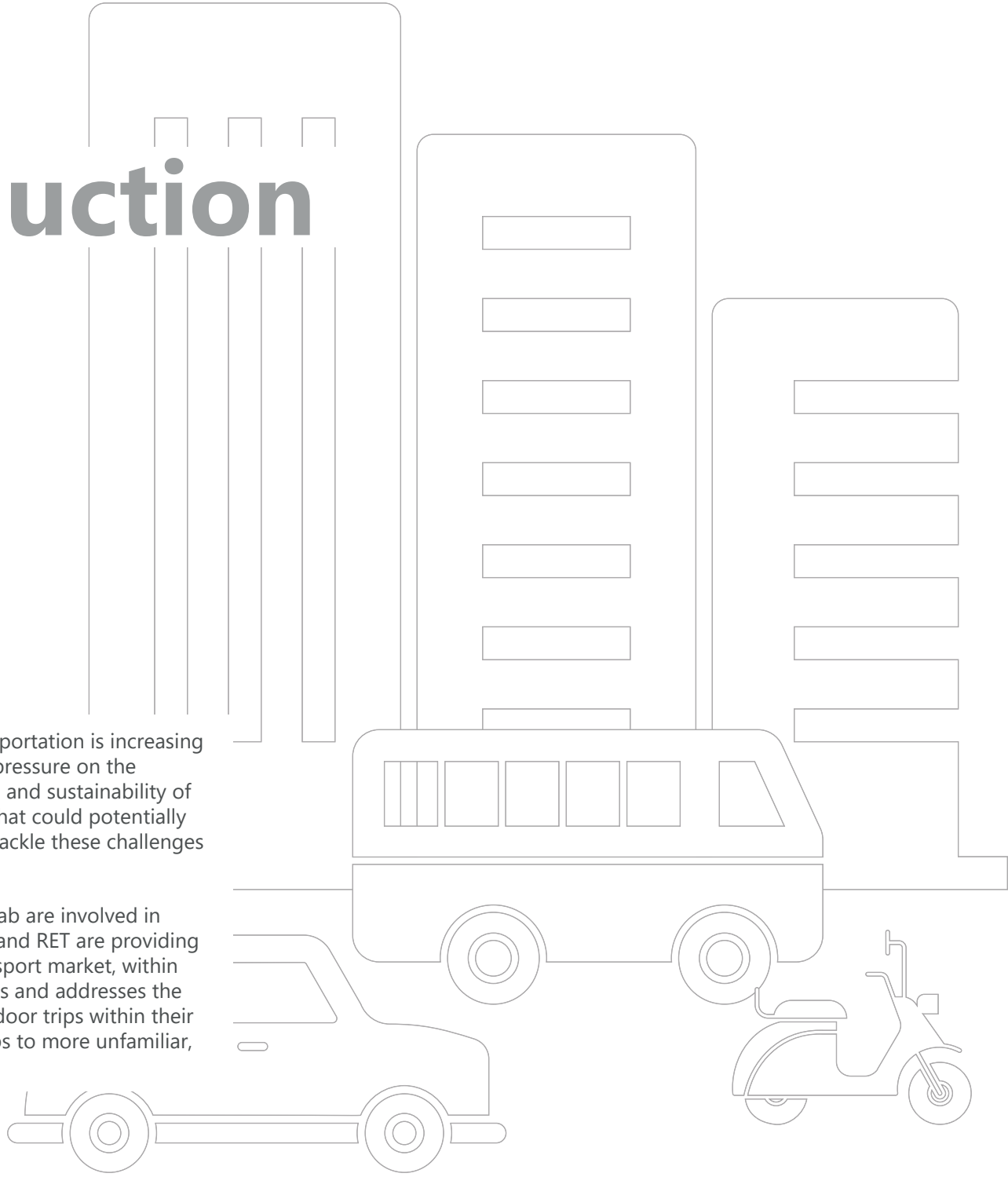
RESEARCH PHASE

Design brief

Design phase

Evaluation phase

1 Introduction



Main chapter insights

With increasing populations, the need for transportation is increasing as well. This creates societal issues generating pressure on the affordability of transport, the liveability of cities and sustainability of mobility infrastructure. The radical innovation that could potentially reform the entire transport system in order to tackle these challenges is Mobility as a Service.

RET, 9292 and the Seamless Personal Mobility lab are involved in developments regarding MaaS. Whereas 9292 and RET are providing their current mobility service to the public transport market, within MaaS this market will broaden. How to supports and addresses the needs and wishes of travellers during door-to-door trips within their own familiar region of Rotterdam as well as trips to more unfamiliar, remote destinations?

Mobility is a huge chunk of our everyday lives. We need a common shared goal of personal needs in combination with societal needs

- Krista Huhtala-Jenks (MaaS Global),
MaaS Congress 2021

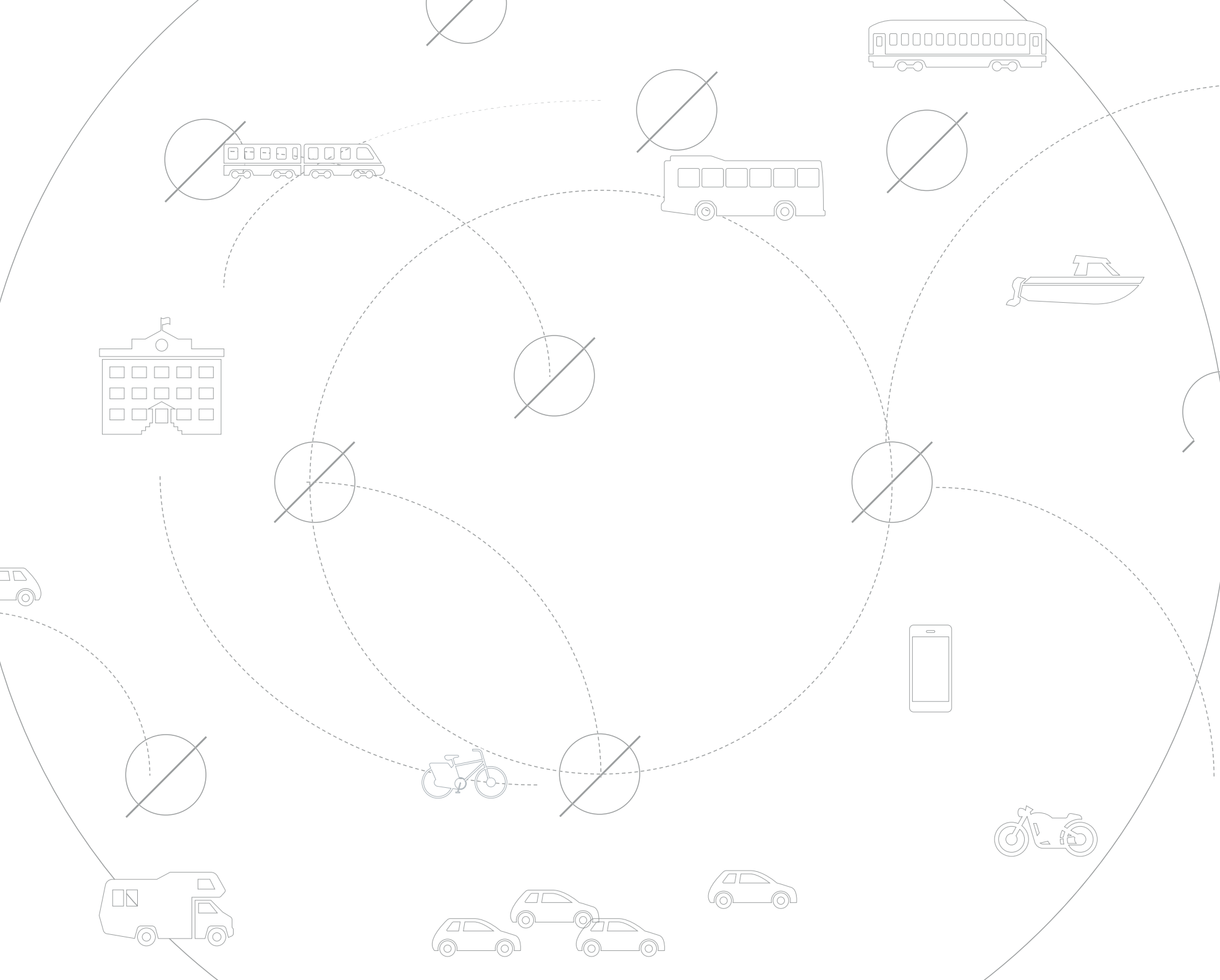
1.1
/ Background

Over the years, the Dutch population is increasing and along with a rising usage of personal transportation, the need for transportation continues to increase as well (Karlsson et al., 2020). This causes an increase in traffic jams and lack of parking space in and around cities. Besides, pressure grows on public transport networks, creating (societal) challenges to continue to fulfil travellers' needs and to remain affordable (Mink, 2021; Rikken, 2016). Along with these societal issues, the world is getting more and more digital, and a platform economy is emerging. These trends are also reflected in the rise of shared mobility providers and on-demand mobility services (Rikken, 2016; Warwick et al., 2017).

Mobility as a Service (abbreviated by MaaS) creates opportunities for cities to overcome these societal challenges by providing seamless, personalised and on-demand multimodal mobility (Sochor et al., 2016). By integrating public, shared, and private transport modalities in one (eco)system, travellers can conveniently travel from door-to-door by a range of different mobility providers. MaaS allows travellers to use a specific modality only when needed, inducing a shift from ownership to use (Araghi et al., 2020; Sochor et al., 2016). Hereby creating potential to establish a shift towards a more sustainable, user-friendly, and futureproof transport system.

For MaaS to become a success, the current way mobility in the Netherlands is organised and offered has to change (Mink, 2021; Warwick et al., 2017). A platform that offers Mobility as a Service has to be realised, current public, shared and private transport providers have to become part of this service. All other services that currently play a role in (public transport) travelling need to adapt to these changes to remain important and interesting.

Apart from the (eco)system having to become ready for MaaS, travellers also need to adopt the use of this system and use it in a way that is beneficial in overcoming the societal challenges (Alonso-González et al., 2020; Sochor et al., 2016; Sochor & Sarasini, 2017). Whereas current developments in the Netherlands are mainly focused on developing governance, policy and setting up collaborations for the MaaS ecosystem, this project addresses the individual traveller and aims to explore how a MaaS service could add value and desirable experiences for the traveller within beneficial developments for society at large.



1.2
/ Project stakeholders

As MaaS embodies a new ecosystem of personal mobility, many different stakeholders must work together to become a success. In this system players have to both collaborate as compete, making the development and implementation of such a service rather complex and challenging. Whereas the mobility sector used to function in distinct silos, to get MaaS off the ground and to be actual able to solve societal issues, these silos must be broken. Collaboration amongst them has to become the new way of working (Kloppenburg, 2019; Mink, 2021). Chapter 3.3. will discuss this more in-depth.

To not remain thinking and designing in one silo, this graduation project is also a collaboration between different stakeholders. Public transport provider of the Rotterdam region RET N.V., independent travel advice provider REISinformatiegroep B.V. |9292 (hereinafter referred to as 9292) and the research lab Seamless Personal Mobility Lab of Delft University of Technology are equal partners in this project. Due to this collaboration, broad knowledge, expertise and network in the field of mobility of both the academical as business sector are brought together.

| 1.2.1 Personal Seamless Mobility Lab

The Seamless Personal Mobility Lab is a Delft Design Lab and part of Industrial Design Engineering faculty of University of Technology Delft. This research and design lab explores "what would be the ideal user experience for future mobility services, in order to generate solutions that match both the needs of travellers and the different mobility stakeholder" (Delft University of Technology, n.d.). The lab consists of researchers, PhD and graduate students. Through its network of various partners in the mobility domain, including RET and 9292, this lab brings in a wide spectrum of mobility expertise and a diverse network of stakeholders involved in MaaS developments.

| 1.2.2 RET N.V.

The company
Founded in 1878, RET started off as a transport company with horse-drawn trams in Rotterdam. Over the 140 years they now exist, they have added metros, busses and a fast ferry line to their service.

RET now accommodates and supports public transport travellers through many different channels, that all have their own functionality: travel information provision, ticketing and payment, support and subscriptions.

Their vision and mission for MaaS
Pressure on public transport is growing. As a public transport provider, RET is struggling to remain affordable and efficient, and to remain providing a good service offer within the entire region. MaaS could help take off some of this pressure by increasing the modality offer (Rikken, 2016). More about this will be discussed in chapter 3.2.

With the introduction of MaaS in the region of Rotterdam, RET wants to take on an active role to ensure a high level of influence of the region. RET's vision is to grow to the mobility director of the region Rotterdam, from door-to-door (RET, 2019). This to ensure they can continue to transport travellers in the growing region, but also to influence mobility developments in the region to be in line with the societal goals. The activities to carry out this vision will be elaborated further in chapter 3.4.

Their challenges for MaaS
Currently, RET has various channels to provide information, travel information, payment information and service. As development takes place outside RET, these apps are developed by different vendors.

RET's challenge is to prepare their infrastructure and channels to adopt Mobility as a Service and provide a user-friendly service on a regional level. In this they need to prevent a sprawl of all these different mobile platforms but integrate it into one environment with RET look and feel.

| 1.2.3 REISinformatiegroep B.V. - 9292

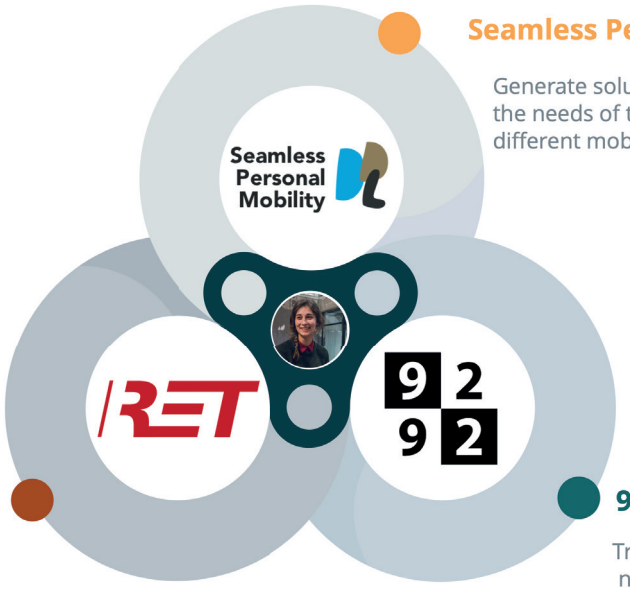
The company
Founded in 1992, REISinformatiegroep B.V. initially started off as a call centre providing travellers information on public transport options and routes. In the years that followed, the service was expanded with information about planned changes, rates, stop information and disruptions in the timetable. They also develop services for the authorities and businesses and from 2012 onwards, they released Open Data.

Currently their main service is providing nation-wide, independent public transport travel information through mobile application and a website, via the brand 9292. These channels have many different functionalities and should have a one-fits-all solution for all its many different types of users throughout the Netherlands.

Their vision and mission for MaaS
By providing public transport travel information, their mission is in its core to make life easier for all people involved in public transport. "Hoe kunnen we je nog beter van dienst zijn? Want waar je ook heen gaat, 9292 reist met je mee." (Translated: How could we be of better value? Because wherever you go, 9292 travels along) (Reisinformatiegroep BV, n.d.-a, n.d.-b).

This mission is focussed on the vision that their main users know what they want; 9292 aims to support them from A to B with public transport. Although, while shifting their current offering towards an all-in-one MaaS service, their current offering shifts from public transport to "mobility at large". The specific activities to that are currently carried out by 9292 that are part of MaaS developments, will be elaborated further in chapter 3.4.

Their challenges for MaaS
Enlarging their current offering also means a broader marketplace with a more diverse group of travellers. 9292's challenge is to remain user-friendly for their existing users and potential new users while adding Mobility as a Service functionalities in their service on a national level. In this they need to prevent a sprawl of functionalities and bring these together in a logical way in their existing channels and technical back-end and architecture.



Seamless Personal Mobility Lab

Generate solutions that match both the needs of travellers and the different mobility stakeholders

RET

Public Transport provider Rotterdam region

9292

Travel information provider nationaal

1.3
/ Challenge

| 1.3.1 Problem statement

The entire way we travel from door-to-door is changing, creating a new ecosystem of personal mobility. For travellers, current developments bring a sprawl in transportation modes, travel possibilities and their associated mobile applications. By unifying this all in one system, Mobility as a Service platforms could provide ease of use by facilitating travellers with their multimodal trips from door-to-door: within their own familiar region or beyond, across a range of transportation modes and also including the first and last mile.

In their base, RET and 9292' offerings are both focused on the public transport market. Whereas RET is offering their public transport services within the region of Rotterdam, 9292 is nationally active as a public transport travel information provider. With the introduction of MaaS this market will broaden. Both players have their own challenges within the MaaS developments, although overlapping is the integration of a service in one platform. Therefore, the combination of their challenges lead to the formulation of this graduation project.

| 1.3.2 Project assignment

"Design a Mobility as a Service concept that supports and addresses the needs and wishes of public transport travellers during door-to-door trips within their own familiar region of Rotterdam as well as trips to more unfamiliar, remote destinations."

| 1.3.3 Problem statement

As a case, this project focusses on travellers living in Rotterdam that travel both within their familiar region of Rotterdam, as well as from Rotterdam to more unfamiliar, remote destinations.

1.4
/ Project approach

The project takes on a holistic perspective, with the user, the traveller in this case, as starting point. It consists of four different stages, based on the double diamond process (Design Counsil, 2015). By diverging and converging in an iterative way and with active engagement of potential MaaS travellers, this project consists of a research phase and design phase.

The research phase is about analysing the problem space and discovering in-depth experiences and user needs. Current developments and the current state of MaaS in the Netherlands is explored, and current travel experiences of travellers and their drivers are unravelled. As MaaS is a very broad and diverse subject and my personal desire to make this graduation project a design project rather than a research project, this research phase is also about scoping the initial project brief. From the rich data collected in the research phase, a solution space is identified. A scope is set to two concrete scenarios of traveling, focused on a clear moment of human-service interaction. This research phase concludes with a design brief that serves as the starting point of the design phase. In this design brief the problem definition is discussed. It concludes with a mission and vision, and the formulation of a design goal.

The design phase is about designing solutions for the formulated design goal. Part of the design phase is the formulation of a design and interaction vision and exploration of concept directions, which results in a period of iteratively prototyping and evaluating. This leads to the creation of the final design. This design serves as the final deliverable and is finally evaluated on usability and desirability with potential MaaS travellers, and evaluated on viability and integrity with both clients as well as other stakeholders within the MaaS domain (Shahbazi, n.d.).

1.5
/ Report reading guide

The structure of this report is in line with the approach of this project. The report is divided in four main phases (I, II, III and IV), that either represent one diamond of the double diamond process, or the transition between them. These phases are divided by chapters. Apart from phase III Design Brief, each phase starts with a chapter elaborating the used methods and techniques in that phase, and could be consulted as reference.

A global overview of the project's approach, report structure and corresponding chapter numbers is illustrated in Figure 1.

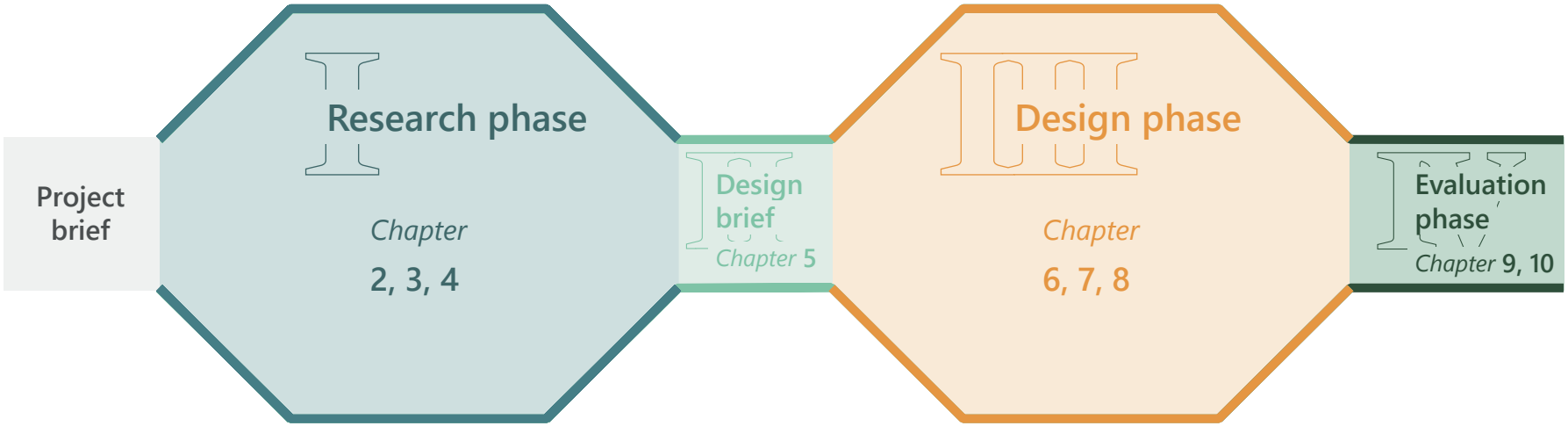


Fig 1 *overview of project approach and activities based on Double Diamond process (Design Counsil, 2015)*

Research

PHASE

This research phase is about

analysing the problem space and discovering in-depth experiences and needs of travellers. Current developments of MaaS in the Netherlands are explored, and current travel experiences of travellers and their drivers are unravelled.

This phase works towards scoping the initial project brief and identifying a solution space to design for, which is discussed in the design brief.

2 Research process & methods

Main chapter insights

This chapter discusses in detail the research approach and corresponding methods that are used to understand the current context of Mobility as a Service and the target group. It could be consulted as a reference to understand how the results presented in the subsequent chapters are formulated.

Designing without research is like getting into a taxi and just saying, “Drive.”

- Facebook Research

2.1
/ Research methods

The following chapter describes the different research activities and methods carried out as part of the research phase. As it serves as a reference for the following chapter, results and insights gathered from these activities are discussed in chapter 3 and 4.

Research is carried out to on one hand understand the current context of Mobility as a Service and the potential it has to solve societal issues, and on the other hand to gain deep understanding in the target group to design for. Figure 2 illustrates an overview of the research phase with the used methods and processes.

| Desk research

Desk research is carried out to gain insights in the existing context, current developments and the state of MaaS in the Netherlands. Literature is also reviewed to explore potential MaaS target groups and to learn from previous MaaS pilots that have already been carried out in other European countries.

Academical literature in the form of academical papers and graduation reports are researched, as well as written reports from the business context and governmental context to gain a broad understanding of the context. Besides, in-house documentation of 9292 and RET are analysed to get insights in the developments and working processes of the differen t collaborating parties. On top of that, a diversity of presentations are attended, like the remote MaaS congress of 2021, and range of podcasts on Mobility as a Service is listened.

| Questionnaire

To get some general insights in current travel experiences, needs and desires of public transport travellers that travel to leisure activities, closed questionnaires are sent out to 9292's panel of 2000+ beta app testers and RET's online panel of about 500 panellists.

The aim was to discover for what leisure activities they travel, how they travel towards these destinations and what factor affect this choice of travel mode. Besides, this research aimed to gain some understanding in the different needs when travellers travelling within their familiar region opposed to travelling to more unknown destinations.

The overall goal was to gather **insights and inspiration** that serve as input for a qualitative group session, dn recruiting participants for a creative session.

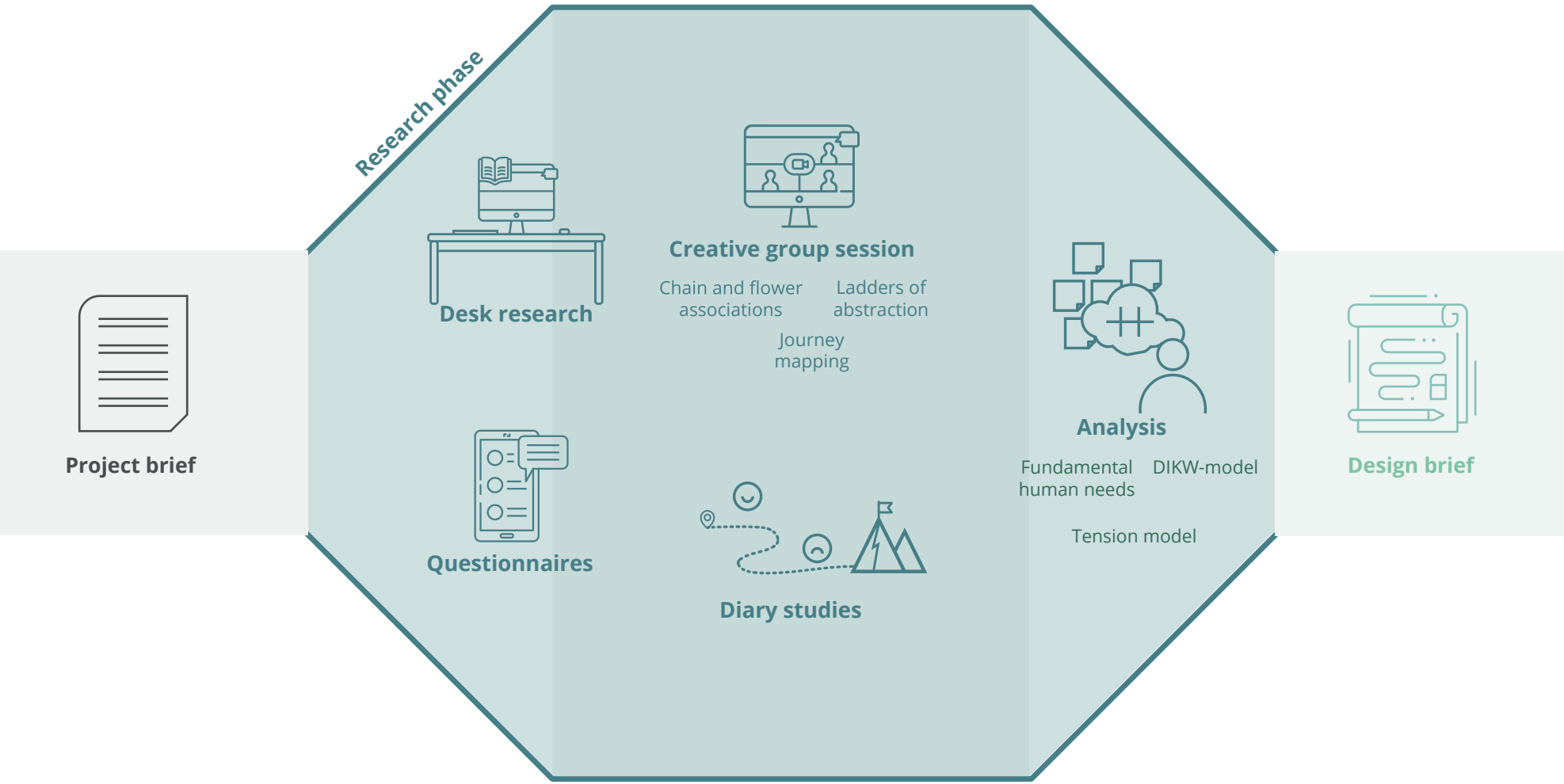


Fig 2 *Overview of research processes and methods*

Fig 3 *Impression creative group session*

The questionnaire to the 9292 beta testers was created with Google Forms and was sent by means of a link in the mobile beta application as a notification and a popup in the app. The questionnaire to the RET panellists was setup in the online tool RET uses for such surveys and sent out through this system which delivers it by means of an email.

The full questionnaires and specific questions could be found in Appendix 13.1

Creative group session

To gather rich data that is needed to allow for emphasising with the target group and to be able to design, a creative group session is held. The focus was on gaining insights in more in-depth latent needs and experiences of travellers that travel to leisure activities (Sanders & Stappers, 2012). An impression of the session is illustrated in Figure 3. The full setup and content of this session as well as the results could be found in Appendix 13.2

Selection procedure
Participants were selected from questionnaire respondents that showed interest in participating in a qualitative input session. Besides, a copy of the Google form 9292 questionnaire, see Appendix 13.1, was shared via the researcher's personal LinkedIn network to also recruit participants that have less of a public transport

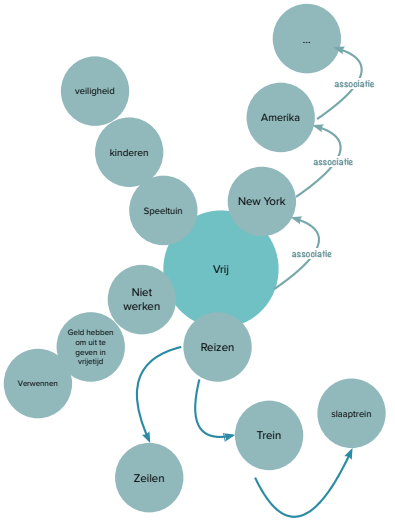
bias. To select a diverse set of participants, the list of interested respondents were clustered on the different personas that RET and 9292 formulated themselves. A set of six participants were selected such to ensure a mix of gender, age, possession of transport modes and assumed RET and 9292 personas.

Methods and techniques
The session consisted of three main activities to support creative thinking: flower and chain-associations, laddering of abstraction technique and customer journey mapping.

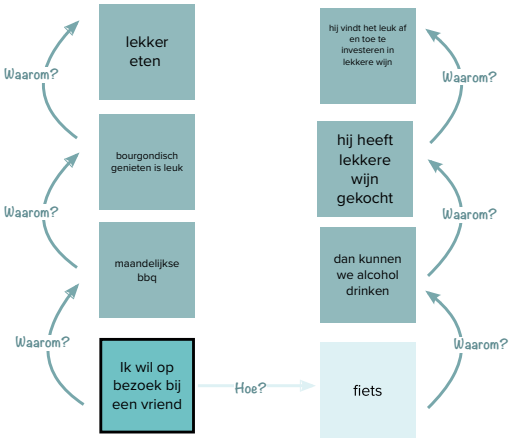
Practical details
The session took two hours and was done remotely via Zoom in combination of the web-based brainstorm tool Mural.

| Flower and chain associations

A word that is related to the problem or subject related to the brainstorm session is put in the centre of the sheet. Participants are invited to writing down words on post-its that are triggered by either a given central theme (flower association) or by a previously noted down word (chain) (Heijne & van der Meer, 2019). As the session was held in April 2021 in the middle of the corona pandemic, this method was used to support participants to distance themselves from current



| Fig 4 *Example of a filled in chain and flower association*



| Fig 5 *Example of a filled in ladder of abstraction*

experiences due to the restrictions they were facing because of this pandemic. Therefore, the central themes of this activity were words like “Free”, “Fun” “Boundless” and “Holiday”.

| Ladders of abstraction

A variation of the ladder of abstraction technique is used to gain more in-depth information about the context and travel needs of the target group (Heijne & van der Meer, 2019). It unravelled in-depth reasons for travelling to leisure activities and reasons for mode-choice. As visualised in Figure 4, participants were

provided with an initial need statement. Participants move a step 'up' in the ladder by asking "Why" by which the initial need statement will reach a higher level of abstraction. They move right by asking "How", which will provide a choice in travel mode in how to reach to the initial need statement. Finally, by asking "Why" on this mode-choice, higher level of abstraction will be reach regarding motives for this travel mode.

| Journey mapping

To get a holistic view of the travel experience by discovering both negative as positive experiences throughout different phases of a trip, a journey mapping activity was carried out as part of an exercise of the creative group session (Kaplan, 2020).

Participants were provided with two different travel scenarios with the same actor and phases of the journey (pre travel, travel and post travel). Participants were in two groups, to which each group mapped a different journey. Within these journeys, they were asked to map actions, considerations and emotional motivations they envision the actor of the journey to experience, throughout the three different phases of the travel journey.

The travel scenarios were drawn up from the insights gained in the questionnaire data. They were focussed on a woman living in Rotterdam. In one scenario, she wants to travel to have dinner with a friend that lives in Rotterdam as well. In the other scenario, she wants to travel to a for her unknown city to enjoy a city-day trip together with a friend.

For both scenarios some specific needs were formulated, although participants were also encouraged to formulate some specific needs themselves.

| Diary studies

During the progress of this graduation project, the researcher encountered some drastic changes in her living context, causing her motivators and needs for travelling to change as well. While living together with her partner, they lost possession of their lease car and took in a puppy. As research shows behaviour is changed and new habits are formed when encountering such major changes in travel company and/or possession of travel modes, these events were taken as a basis for research explorations within this project (Durand et al., 2018).

These changes opened opportunities to take on a new perspective and open-mindedly observe and analyse a range of journeys in the form of self-carried out diary studies (Salazar, 2016). This study allowed the

researcher to delve into the process of forming new habits or routines for travelling to leisure activities and to understand how mode-choice is affected.

Practical details
The researcher lives together with her partner in the city of Rotterdam in Kralingen. This is an urban area with a dense public transport network and in which many different 'new' mobility services are offered. More info about such services could be found in chapter 3.4.

Method
A diverse range of trips were analysed in which different modalities were used amongst all possible transportation modes in the living region of the researcher (Rotterdam) as well as from the region of Rotterdam to more unfamiliar destinations. Besides, the company the trip was undertaken with differed from with/without dog and/or partner.

While undertaking these trips, the researcher and her partner mapped out their considerations and experiences in simple maps. The logging period entailed the first four months of the graduation project, and the data logged was amongst others: travel scenario, context and company, main travel need and driver, travel mode and reason for mode-choice. An impression of such journeys are illustrated in Figure 6.

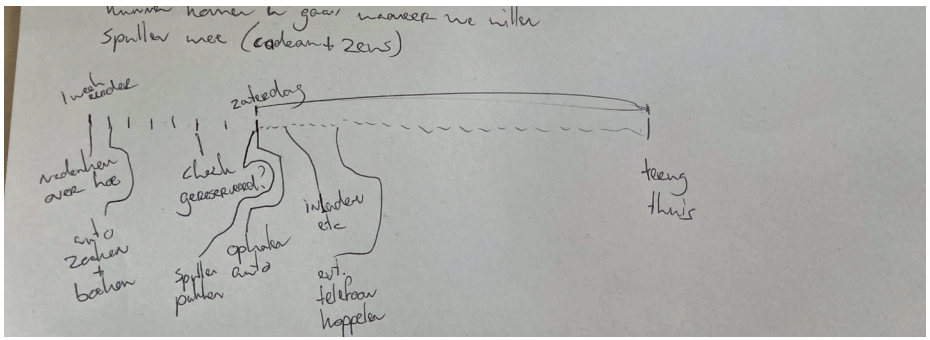
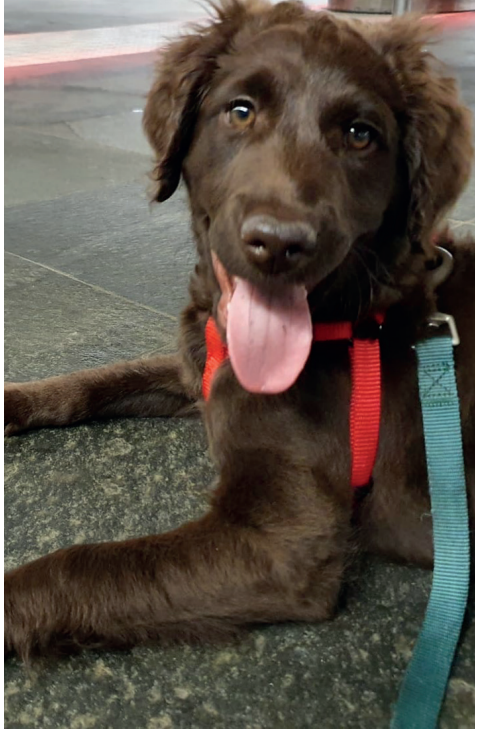
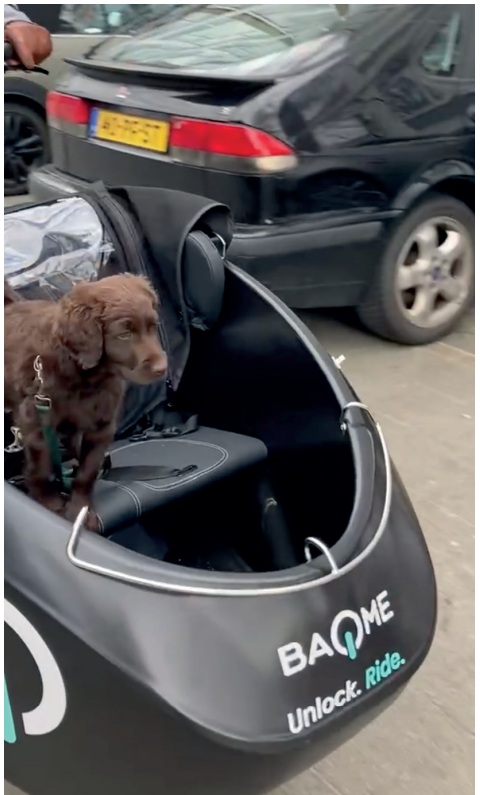
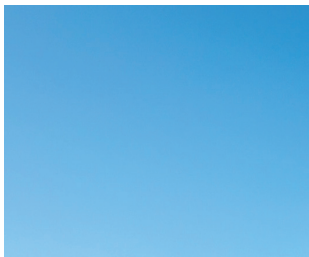


Fig 6 *impression of diary journey*







2.2
/ Analysation methods

Fig 7 *example of an insight card*

| DIKW model

To analyse data in a way it is more generalizable and such that a higher levels of abstraction is reached, the data is analysed in line with the DIKW-model proposed by Sanders & Stappers (2012). Rather than using the raw data to brainstorm for solutions, thís strategy helps to search for alternative solutions, learn to understand the bigger picture and thereby find answers on a higher level of abstraction that are more generalizable.

All collected data from the research phase is stored and retrieved and turned into information by means of insight cards, see Figure 7. These cards are inspired by statement cards (Sanders & Stappers, 2012). By comparing and clustering these cards, knowledge is gathered in the form of patterns and bigger picture is discovered, as is illustrated by Figure 8.

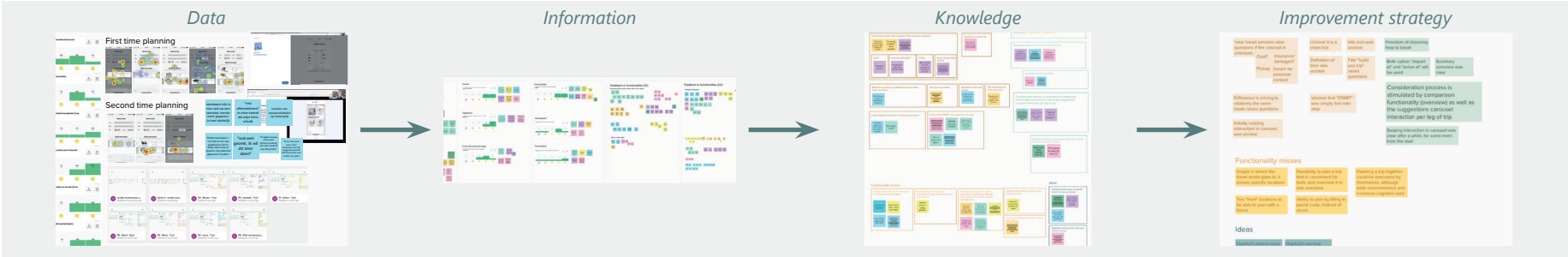


Fig 8 *Process of DIWK*

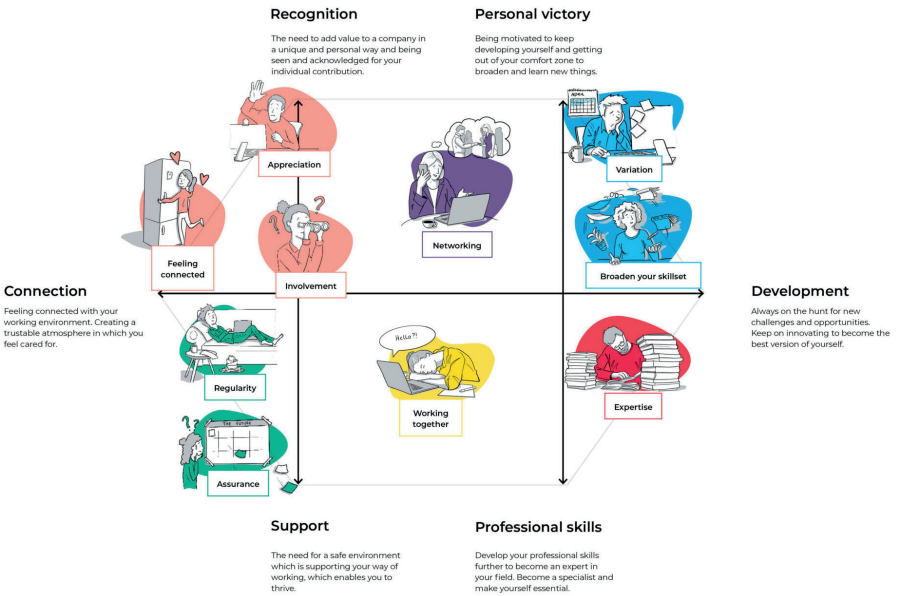


Fig 9 *example of a tension Model by Koos Service Design (ten Bosch, 2021)*

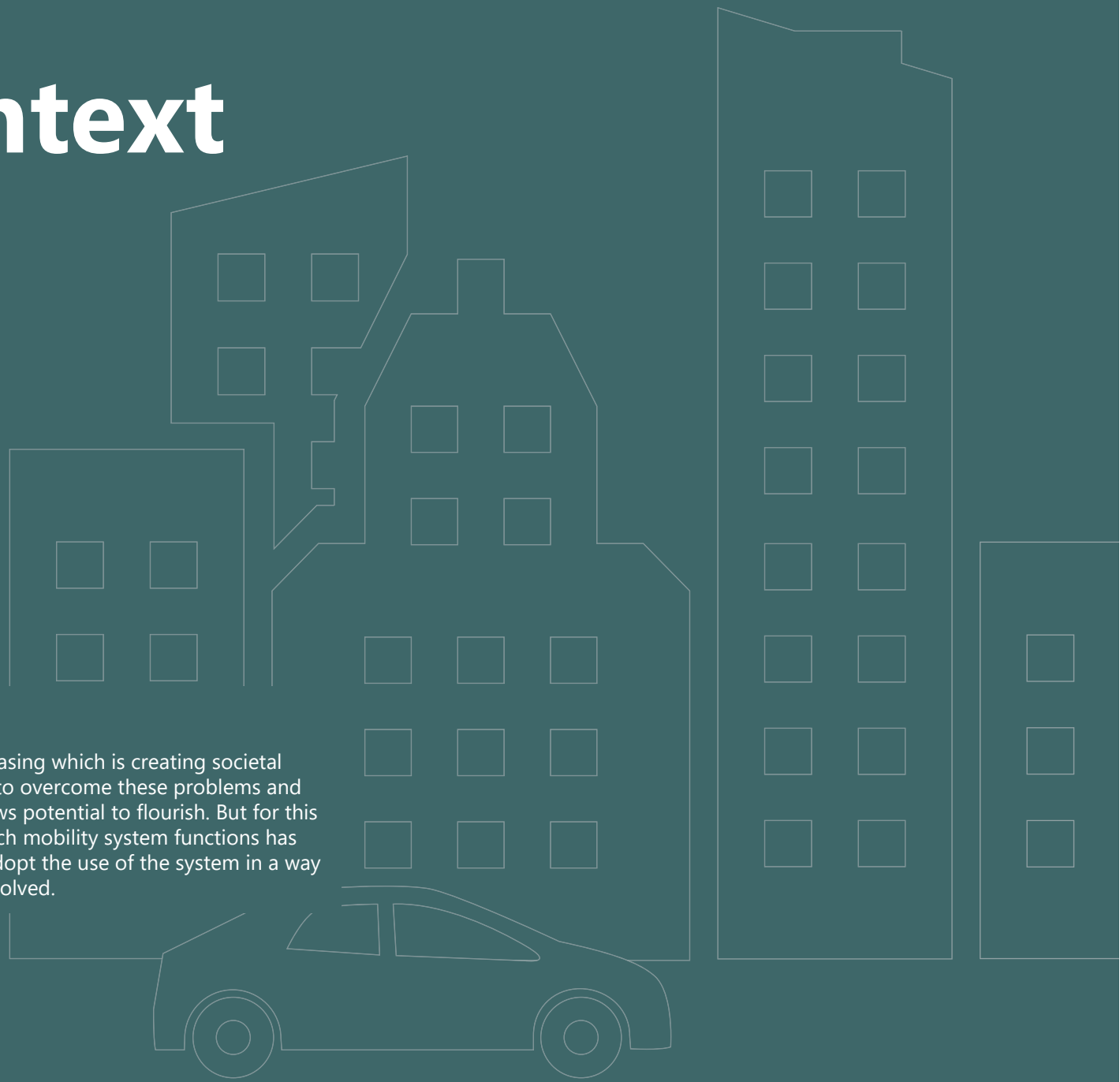
Fundamental psychological needs

To unravel in-depth needs of the travellers, the ladders of abstraction are categorised by the set of thirteen fundamental physiological needs that are formulated by Desmet and Fokkinga (2020). This topology supports to determine and communicate the experiences and needs a traveller might have when travelling for leisure activities.

Morphological tension model

Another way to analyse user needs and drivers is by formulating a tension model. Inspired by Morphological psychology by Saber, this method focusses on finding out subconscious emotional structures in everyday behaviour. It allows to discover different target groups based on travel-needs. The method argues that experiences include six key drivers that relate to each other in the form of tensions (Koos Service Design, 2021). By researching experiences, needs and motives for travelling to leisure activities, and mapping these drivers and needs on three axis of tension, different clusters could be discovered. An example of such a model is represented in Figure 9.

3 Context



Main chapter insights

The need for transportation is increasing which is creating societal issues. MaaS creates opportunities to overcome these problems and given the current trends it also shows potential to flourish. But for this to happen, the current way the Dutch mobility system functions has to change, and travellers need to adopt the use of the system in a way that societal issues will actually be solved.

"A winner takes all" is a doom scenario for MaaS in the Netherlands

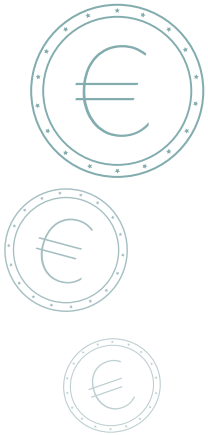
- Erik Mink, Ministry IenW *MaaS congress 2021*

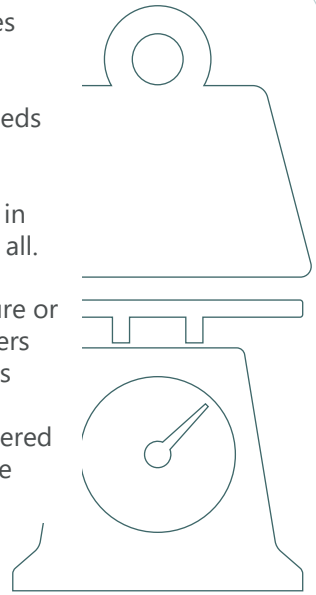
3.1
/ Societal problems

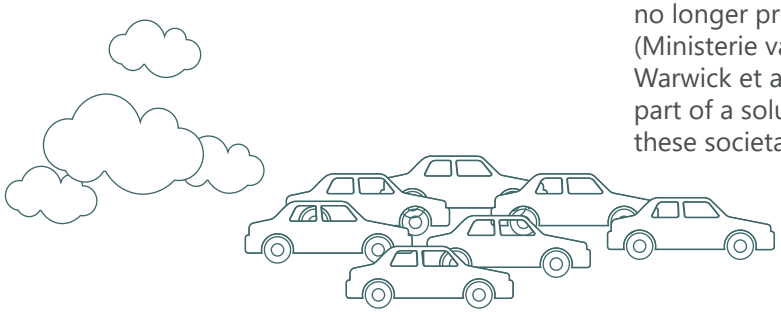
Mobility is vital for the functioning of cities as well as for the functioning of countries. Declared by the Universal Declaration of Human rights, people have to be able to move from one place to another (The United Nations, 1948). But with an increasing population and rising usage of personal transportation, both in the Netherlands as on a global level, the need for transportation continues to increase as well. It results in a range of societal problems that have to do with people moving from A to B.

Mobility growth leads to increasing emissions, noise, congestion, overloaded infrastructures and burdensome mobility peaks (Karlsson et al., 2020). This growth and the increasing desire for personal mobility generates pressure on the mobility infrastructure and public transport providers to remain affordable for all and creates challenges to continue to fulfil travellers' needs (Ministerie van Infrastructuur en Waterstaat, 2019; Rikken, 2016). Cities struggle with a lack of parking space in and around cities and they face difficulties in providing a safe and healthy living environment for all.

Standard solutions like investing in new infrastructure or granting extra subsidies for public transport providers no longer provide the desired future proof solutions (Ministerie van Infrastructuur en Waterstaat, 2019; Warwick et al., 2017). Mobility as a Service is considered part of a solution or even the holy grail to overcome these societal issues (Karlsson et al., 2020).







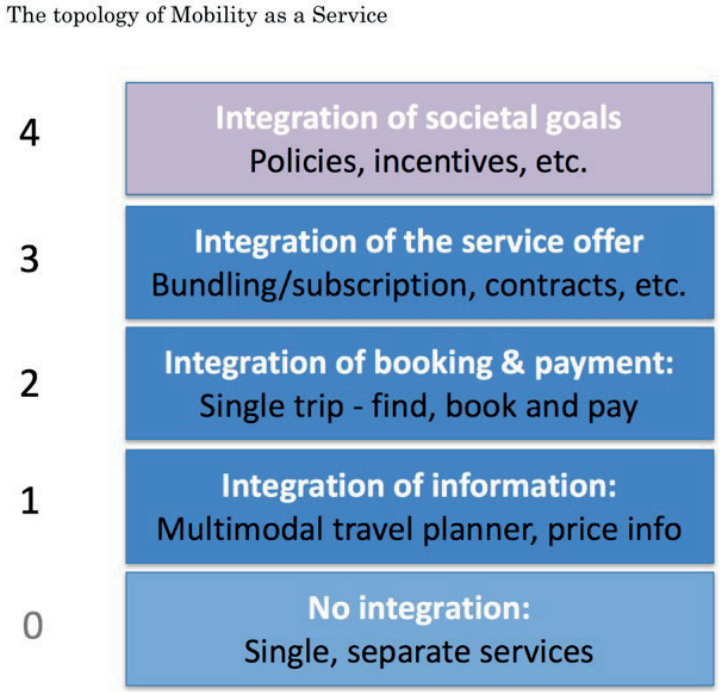
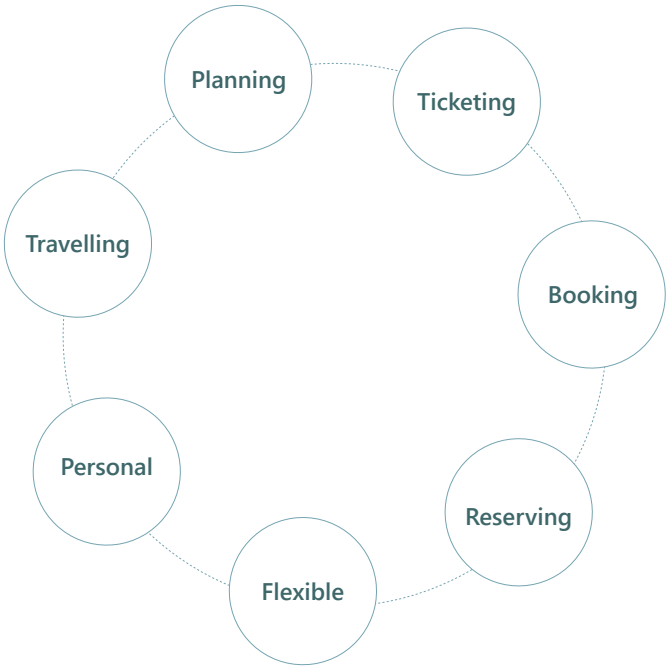


Fig 10 *Proposed topology of MaaS including levels 0-4 (sochor et al., 2018)*

3.2
/ MaaS as a Solution?



MaaS is envisioned as a radical innovation that could potentially reform the entire transport system in order to tackle mobility and sustainability challenges. As there is no established definition of MaaS, Sochor et al., (2018) carried out a literature review that concludes that MaaS is about offering a service focussed on the needs of the user (the traveller) that is about offering mobility rather than transport. The service offers an integration of transport services, including information, payment and ticketing. In short, it could be defined as a concept about "combining all forms of personal transport together into seamless trip chains, with bookings and payments managed collectively for all legs of the trip" and "offering the individual traveller need-based, tailor-made mobility solutions" (Sochor et al., 2016, 2018).

Existing MaaS services differ in terms of the level of service integration. Therefor, Sochor et al. (2018) propose a topology that characterizes five different levels of MaaS service integrations, see Figure 10.

The Dutch government also formulated seven aspects a full-fledged MaaS concept should consist of (Mink, 2021). These are: planning, ticketing, booking, reserving, travelling, flexibility and personalisation.

Potentially evoke behaviour change
With MaaS, travellers could potentially be enhanced in their travelling from door-to-door by a range of different mobility providers, facilitating convenient multimodal travelling. The expectation is by making the wide range of mobility convenient and easily accessible and by stimulating multimodal travelling, travellers will be better able to choose and combine the most appropriate alternatives for their various transportation needs and trips. They could find better fitting solutions and make travelling possible across all accessible transportation modes by enhancing convenience and ease of use in a personalized way (Sochor et al., 2016).

Flatten mobility peaks
Implementing such a service opens opportunities to operate current infrastructure more efficient and effective. By stimulating travellers to make better use of all existing transportation modes, the overall mobility load could be spread out across modes and moments, allowing to divide capacity better and flatten mobility peaks (Bingen & Spijkers, 2021; Mink, 2021).

Increase reachability
Besides, locations that are currently hard to reach by public transport could be reached by means of other mobility providers available. First- and last-mile transport could in this way be deployed to increase reachability of the region (Rikken, 2016).

From ownership to use
MaaS could potentially establish a more sustainable and futureproof transportation system.
It aims to offer interesting alternatives to private vehicle ownership and could prompt travellers to use a specific modality only when needed. If this leads to successful behaviour change, it will stimulate a transition from mobility as a commodity to mobility as a service (Araghi et al., 2020; Vonk Noordegraaf et al., 2020). This shift from ownership to use is desirable as this could mean that current infrastructure could be used more effectively and (cost) efficient. It could also imply less mobility, less emissions, less use of the increasingly scarce public space, and positive environmental effect by sharing modalities opposed to privately owning vehicles (Rau & Oberhuber, 2016).

Current societal trends
Given the current trends of an increasingly digitalising world, the emergence of a platform economy, and the speed in which New Mobility Services are arising, MaaS has potential to succeed (Warwick et al., 2017)

In conclusion, MaaS creates opportunities for cities to tackle previously discussed societal challenges by providing seamless, personalised and on-demand multimodal mobility. But for MaaS to become a success in the Netherlands, the current way mobility in the Netherlands is organised and offered has to change.

3.3
/ A successful Dutch MaaS

Currently, the Dutch mobility landscape is like a patchwork of businesses and governmental organisations, and policy and governance. It is very much based in silos, which makes it ineffective and difficult to innovate (Bingen & Spijkers, 2021; Kloppenburg, 2019). To get a successful MaaS concept off the ground, a broad range of mobility players have to become part of one system. Public, shared and private transport providers, but also governments and other players that play a role in travelling need to collaborate but also compete in one complex landscape.

A Dutch MaaS (eco)system must be developed. To be able to function in the same system in a fair and equal way, these players all need to be able to communicate and function according to the same rules.

As MaaS is envisioned as a radical innovation, the entire mobility ecosystem will shift. To remain important and interesting current players in the Dutch mobility network need to adapt to these changes.

Apart from the (eco)system having to become ready for MaaS, travellers also need to adopt the use of this system. As described by Rogers et al., (1971) "Adoption is a decision to make full use of an innovation as the best course of action available" and "Rejection is a decision not to adopt an innovation". Low uptake of use and adoption of travellers will make MaaS unsuccessful (Smith et al., 2019). On the other hand, high adoption of mainly the "Maas-ready" target group, could induce the risk that the impact on current mobility systems increases. This could mean that the societal problems discussed earlier will worsen instead of improve. Chapter 4.2 will elaborate further on this.


The current
mobility
landschape has to
change

3.4
/ Current developments

| Dutch Ministry of IeW & national pilots

A MaaS ecosystem consist of numerous different players that all have different needs and values. This makes it rather challenging and complex to get off the ground. Public-private collaborations is a key to success, therefore fairness, rights and obligations should be guaranteed for all (Hogenboom, 2021).

As Dutch public authorities acknowledge the potential of MaaS to tackle a large variety of societal issues, they are actively engaged in trying to develop MaaS (Vonk Noordegraaf et al., 2020). To create a fair-playing field, the Dutch Ministry Infrastructure and Water Management (abbreviated by IenW) is taking a role in policy making and initiating the development of technical standards in the form of a universal language; the TOMP-API (Mink, 2021). This 'Transport Operator MaaS provider' API is to allow for communication and transferring data to booking trips and corresponding assets between MaaS providers and transport operators.

Together with the seven Dutch regions, the ministry also initiated and supports seven scalable national pilots. These are to stimulate collaboration between parties and create room to gain and learn from MaaS experiences and to expand knowledge about mobility. The overall

three goals of this MaaS program are:

1. The traveller can choose from all combinations of transport options, and plan, book and pay for them, by linking travel data and offering seven very user-friendly apps. The privacy of the traveller is thereby guaranteed.

2. Gaining and learning from MaaS experiences and expanding mobility knowledge. Good applications and sufficient users are preconditions for this.

3. Taking the first step towards a sustainable transport future with MaaS, where ownership is less important and service provision becomes more important.

These pilots are each focussed on a policy goal or target group: from accessibility to social inclusion to sustainability, from cross-border transport to congestion prevention (Ministerie van Infrastructuur en Waterstaat, 2019). They result in result in eight national mobile applications.

The pilots were aimed to start in phases in the autumn of 2020 to run for 2 to 3 years. Due to the effects of the Corona pandemic, the launches of the pilot apps were delayed. During the progress of this graduation project these pilots are released live.

| Collaboration as part of the MaaS-lab

To create the right preconditions for a healthy and optimal MaaS system in the Netherlands, the MaaS-lab is initiated. Facilitated by the KNV, the lab is a collaboration of parties from the business field that are involved in MaaS developments. This lab has three focus points. It aims to reach to an agreement system ('afsprakenstelsel') regarding data sharing and cooperation in specific working groups, advocates for a level playing field. Besides, it serves as a discussion partner for national, regional and international governments and other stakeholders. And thirdly, it aims to create a network for knowledge sharing at national level in collaboration with VNO-NCW, CROW, Connekt and Railforum and at international level in collaboration with UITP, IRU and MaaS Alliance (Koninklijk Nederlands Vervoer, n.d.).

| Changing existing mobility services

Besides the MaaS developments as part of the pilots, current service providers in the mobility sector also carry out own initiated developments along the line of MaaS. By broadening or shifting their core business, they are (slowly) adapting their offerings or activities to remain important and interesting. For example, public transport providers like RET, HTM and NS are expanding their services to include multiple

modes in their current apps. But also 9292 is adding functionalities to their existing PT travel information provider application (Vonk Noordegraaf et al., 2020).

This shows that the partners of this project are also actively involved in the developments of MaaS. As discussed before in chapter 1.2, 9292 takes on an active role to remain providing an interesting service for travellers and is enhancing its current offering. RET is engaged to take on the role of Mobility Director in the Rotterdam region, in which MaaS is part of the strategy.

During the progress of this project, RET carries out different activities as part of their goal to become the mobility director of the region. One of those steps is to formulate a clear vision on how take on this role, and to formulate a strategy with a roadmap to realize this vision. MaaS is part of this plan, where a first step has been taken by setting up a joint venture called, Rivier.

RET's activities in MaaS
Rivier is a joint venture with HTM and NS. The objective of this joint venture is to develop a 'power socket' to realize an easy integration of various providers within a MaaS platform. The idea of this product is that it functions as a medium other mobility providers could plug their offerings onto. By this means Rivier could facilitate data communication and transfer amongst providers, facilitating a technical platform a MaaS provider could use as a base for the service.

Besides this joint venture, RET also is rethinking their current way the service and channels are integrated. Currently service touchpoints to support their travellers are available on many different channels. To become mobility director, RET strives for a one-stop-shop approach for all parts of the customer journey. This means a traveller should be able to fulfil its needs in travelling in the region via one channel: travelling, payment and ticketing, but also the contact point for communication with and about RET and its products.

Besides these developments, RET also takes on an active approach in setting up good collaborations with all mobility providers in the region, to cooperate successfully within MaaS.

9292's activities in MaaS
9292 is involved in one of seven the MaaS pilots. They are enrolled as a subcontractor in the pilot of Rotterdam, The Hague and airport, which has a goal to ensure better multimodal accessibility of the Rotterdam and The Hague region. The pilot is a collaboration between Pon, Tranzer and 9292, with Pon on the lead. The three parties work together to share knowledge and expertise, but all develop a different mobile application focused on a different market. Whereas Pon focusses with "MOVES" on the commuter market, 9292

focuses on the consumer traveller with “9292 moves”. With their equally named app, Tranzer focusses on the touristic market. Taking part in this pilot provides 9292 the freedom to explore and develop a service and associated functionalities for a broader market of different travellers.

Apart from the developments as part of the MaaS pilot, 9292 is enriching their current application and service with functionalities to support multimodal door-to-door travelling on the broad sense. During the progress of this graduation project, these developments are in full swing. For example, features like ticketing and planning different shared mobility offerings are added to the planner. These developments cause the current 9292 product to move higher up in the previously discussed MaaS Levels (Sochor et al., 2018).

Besides, 9292 takes part as well as leads in a working group about the ‘Afsprakenstelsel’ that is part of the previously discussed MaaS-Lab.

| New mobility services

In addition to current players changing or enhancing their offerings to provide MaaS services, there are also new businesses arising with the mission to offer a MaaS servce and take on the role as a MaaS provider. An example is Innovactory with their Gaiyo application (Innovactory International BV, n.d.). Besides, a wide range of new mobility initiatives and start-ups are arising. From shared electric mopeds to bikes, from shared cargo bikes to a broad range of different car sharing initiatives like ride sharing, ride pooling and ride hailing; many different concepts are immerging not only in the Dutch cities, nationwide and globally as well (TNO, 2020).

| Compared to Europe

In the Dutch mobility landscape, MaaS is still in its infant phase. When comparing the Netherlands to other European countries, initiatives and developments towards an integration of a MaaS ecosystem are in other countries already a lot further. Some European countries have already completed MaaS pilots, other countries have even rolled out MaaS services in their mobility landscape. This is interesting, as we can learn from their acquired knowledge and experience. In Europe some successful MaaS pilots ran, like UbiGO (Sochor et al., 2015), but in general there is a low uptake and utilization of MaaS services throughout Europe.

4 The traveller to leisure activities

Main chapter insights

Whereas current developments regarding MaaS in the Netherlands are mainly focussed on creating a base on technical and policy level, this graduation project puts the individual traveller central.

A scope is set on travellers that travel to incidental leisure activities. Various research activities are carried out to unravel true needs and experiences of this target group. This chapter concludes with elaborative summary of the target group and their key drivers, needs and current experiences while travelling to leisure activities.

Little user-centred research can be found on MaaS with regards to travellers

- Claudia Spaargaren, (Seamless Personal Mobility Lab

4.1
/ The user central

Putting the traveller central in MaaS developments is essential to generate a successful mobility paradigm shift (Huhtala-jenks, 2021; Scaramelli, 2021; Sochor & Sarasini, 2017). Karlsson et al. (2020) described an analytical framework of assumed (inter)dependencies between different levels and actors in the development and implementation of MaaS (see Figure 11) in which the traveller is also clearly represented. Despite this necessity is being extensively emphasized by experts and written literature, current activities regarding MaaS in the Netherlands show little integration of this traveller perspective. Developments from Dutch governments as well as from industry parties are mainly focussed on creating a base for MaaS development. The process feels rather 'policy and tech pushed'.

This principle of a user-centred design approach for innovation is deeply embedded in the researchers' way of working. While keeping in mind 'SOCIETY at large', the focus of this project is on the 'MICRO level' (Karlsson et al., 2020): the individual travellers. By starting from this traveller perspective, this project takes on a holistic approach to design a service that is societal responsible, technically feasible, business viable and desirable for the user.

What added value is MaaS providing travellers, or what problems or pains could MaaS solve for them? How to design a system that provides travellers a solution for a societal problem that they do not directly experience themselves?

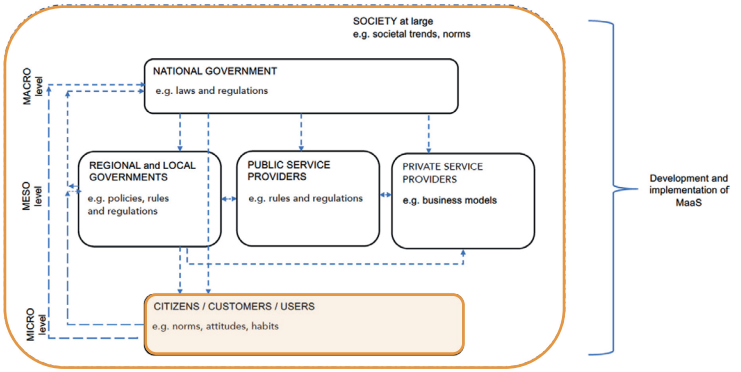


Fig 11 *basis for analytical framework for the development and implementation of MaaS (Karlsson et al., 2020)*

4.2
/ Scoping target group

Rescope and narrow initial target group
At the start of the project and initiated by the clients, the initial focus is to target Dutch public transport (PT) travellers. Both RET as 9292 are in their core offering their service to this group of travellers and thus positioned in the PT market. Therefore, extensive knowledge and expertise about this type of traveller is available.

Although, MaaS will evoke a mobility paradigm shift from offering 'transport' to offering 'mobility'. This will automatically mean that the parties' current target market will also broaden. As discussed before, it is essential for both parties to be part of these MaaS developments, but it is also essential to not cannibalise their own core business that is focussed on the PT traveller.

The puzzle of creating a successful MaaS concept has a high level of complexity and is therefore challenging to solve. The more concrete the scope of this project is set, the better the context and problem could be understood; therefor it is essential for this project to narrow the scope to a more specific target group.

Potential early adopters that are willing to change into more desirable behaviour
As previously discussed, MaaS is a new innovation that could potentially solve societal challenges that have to do with people moving from A to B. For this to happen, travellers need to adopt the use of this service, but it

should also persuade current travel behaviour into more societal desirable travel behaviour. It should, for example, stimulate travellers in taking on a less car-oriented lifestyle or making better use of all existing service offerings. Therefore, a target group has to be found that shows on one hand potential in adopting this new mobility service, and on the other hand shows potential in inducing a change of current behaviour into more societal desirable behaviour.

Focussing on "MaaS ready travellers" comes with risks
Research shows that the most promising target groups for adopting this new mobility service are young people, living and working in urban areas that have no children nor in the possession of a car. It is a group of people that value flexibility in mobility, are already travelling in a multimodal way and use public transport a lot (Alonso-González et al., 2020; Sochor et al., 2015; Sochor & Sarasini, 2017). Although mainly focussing on this target group could cause a conflict to overcome societal issues that we are aiming to solve with MaaS. If initiatives are mainly focused on persuading this group of "MaaS ready travellers" to adopt MaaS by reducing the threshold of using a wide range of mobility alternatives, there is a probability that mobility will increase (Alyavina et al., 2020; Rikken, 2016; Sochor, 2021). Research has shown that travellers could replace short distance trips that used to be made by foot or bike, with public transport or other mode alternatives like shared mopeds or shared cars (Lindeman, 2018). And that MaaS users may substitute PT journeys with car sharing services (Hensher, 2017). This is concerning as it might even increase the impact on current mobility systems and could mean that the societal problem discussed earlier will increase as well. Therefore, this project aims to focus not necessarily on this "MaaS ready" target group.

Focus on a travel need-based target group
Different experts stress that mobility is about the reason for moving, about the reason for travelling. Most of the time, mobility is a means to an end, and the choice for modality (so called mode-choice) depends on specific travel needs (Scaramelli, 2021). Demographical data like age, sex and profession are important factors that affect people's travel behaviour and possibilities, although one and the same person still shows very different travel behaviour and mode choice. For example, a student commuting to school might strive to travel efficiently and quick, whereas a trip to transport new furniture induces mainly the need to transport the new purchase conveniently. One and the same student can be carrying out these trips, although in both scenarios (s)he is in a different travel need-group. The context of travelling and underlying needs that need to be fulfilled influence travel behaviour also very much. Therefor this research focuses not on a target group based on demographics nor a specific type of traveller, but rather on a target group based on travel motives that come with specific trip-dependent needs.

The vision is that once focussing on designing for a travel need-group, overlap could be found between diverse groups of travellers, see Figure 12. Assumingly,

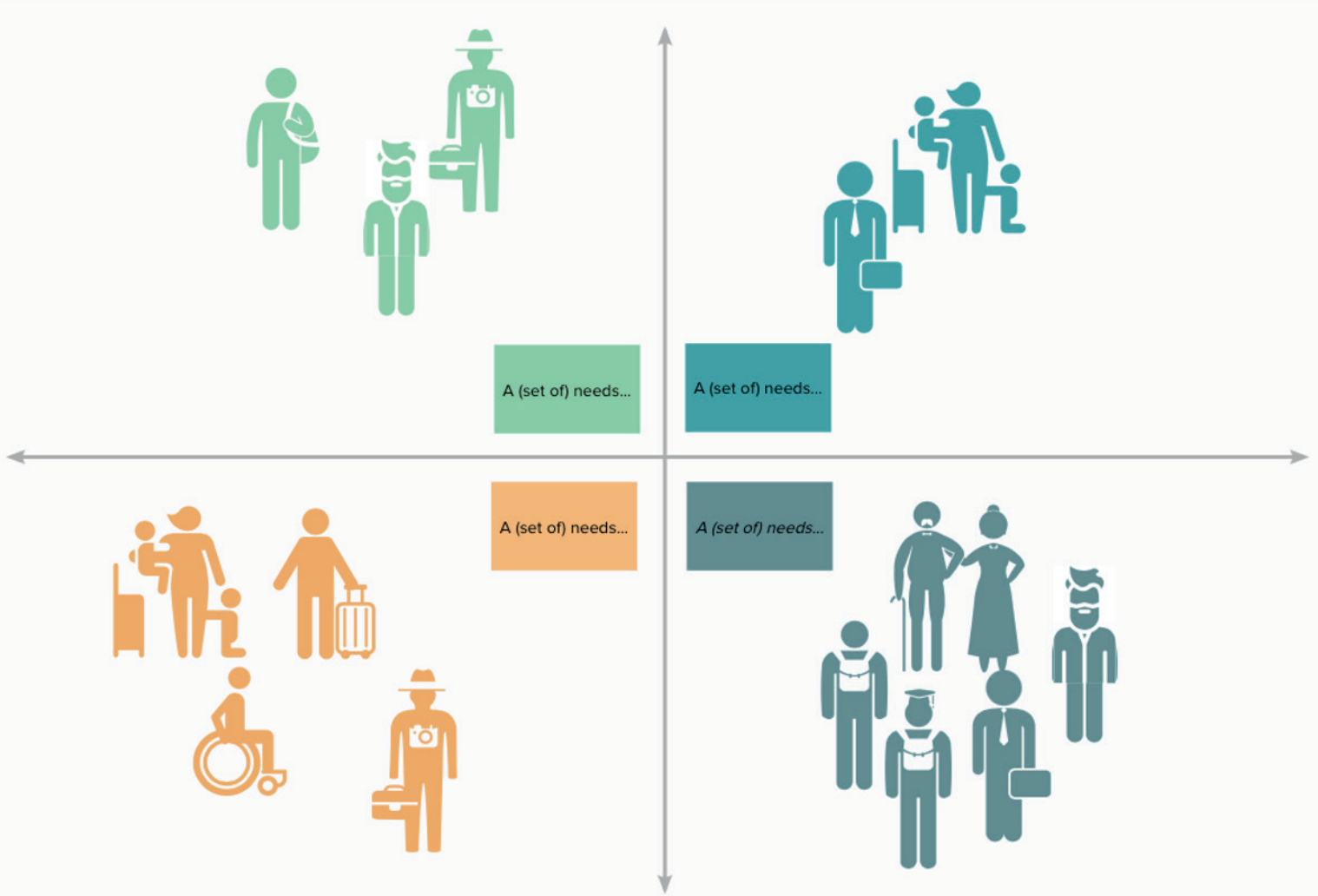


Fig 12 *example of how different target groups could fit in different need-based groups*

in this way you not only design to support the 'MaaS-ready-but-potentially-harming-societal-issues' group of travellers. By improving the travel experience that is focussed on a specific set of travel needs and drivers, MaaS could be providing an added value for a broader group of diverse people.

In search of this 'travel need-group' to focus on, it became important to scope to a specific reason for travelling. Multiple research shows that MaaS would be attractive for leisure trips (Harms et al., 2018; Sochor & Sarasini, 2017). Also, Vedagiri and Arasan (2009) note that mode shift behaviour is more likely for leisure trips than for work trips. As introduced at the beginning of this chapter, for MaaS to be successful in solving societal issues, it is important a certain behaviour change will occur. Therefore, this project concentrates on researching whether there could be ways to add value to people that travel to leisure activities.

MaaS is a new innovation, therefore a large number of travellers have to adopt it to become successful (Rogers et al., 1971). De Verkeersonderneming (2019) shows that on average 50 percent of traffic consists of incidental travellers. Focussing on aiming to change behaviour of a flow of visitors who, wherever they might go, represent very large numbers on the road and in public transport, feels like a promising strategy.

Hence this project focusses on travellers that travels to incidental leisure activities.

To discover different travel need-groups, it is important to unravel different drivers and needs when travelling to incidental leisure activities. Therefore, user research activities are carried out understand how travellers currently travel for such activities, how they decide on this way of travelling (mode-choice) and what their current experiences are.

The next two subchapters will elaborate on the insights gained in these different user research activities, and concludes with a summary of this traveller.

4.3
/ Insights from user research activities

Various research activities are used to gain insight in Dutch travellers and their current experiences and drivers when travelling to leisure activities. Desk research as well as a combination of quantitative and qualitative user research is carried out to find out what specific scope, moment of interaction and travel need-group to focus on. What are the motivations or drivers for people to travel for leisure? How do they travel towards these destinations and what are the factors affecting their modality choice? Besides, are there different needs when travelling within one's familiar region opposed to travelling to more unknown destinations?

Whereas the research methods are elaborated in chapter 2, this subchapter describes the main results and insights per user research activity.

Main goal

Gaining some quantitative insights mainly to get inspiration and input for a qualitative group session, as well as recruiting participants for this session.

Main activities

A questionnaire is sent out to 9292 beta testers and RET panellists. Questions were multiple choice and focussed on finding preference in mode choice and drivers. The main questions were about indicating three main motives for travelling to leisure activities, three main mode-choice for travelling and three main reasons for travelling by this mode. These questions are asked for travelling to destinations both inside as outside of one's own region.

Amount of respondents

Total of 80 beta testers from 9292 app and 217 panellists from RET online panel

More details

The full questionnaires and results could be found in Appendix 13.1

Panel questionnaires /

Main results

The main results are presented in the following graphs (13, 14 and 15). These graphs show the results on respondents' reason for travelling to leisure activities, mode choice for this trip, and main reason for this mode choice regarding a trip destination within their own region as well as outside their region. Data is presented per group of respondents (RET or 9292).

In addition to these graphs, 98 out of 218 RET respondents indicate to use their own car as one of the travel modes when travelling to leisure activities outside the region. Of this group, 70 respondents (71,4%) also use their own car for such trips inside the region. 20 out of 80 respondents of 9292 indicate to use their own car as one of the travel modes when travelling to leisure activities outside the region. Of this group, 15 (75%) respondents use their car for such trips inside the region as well.

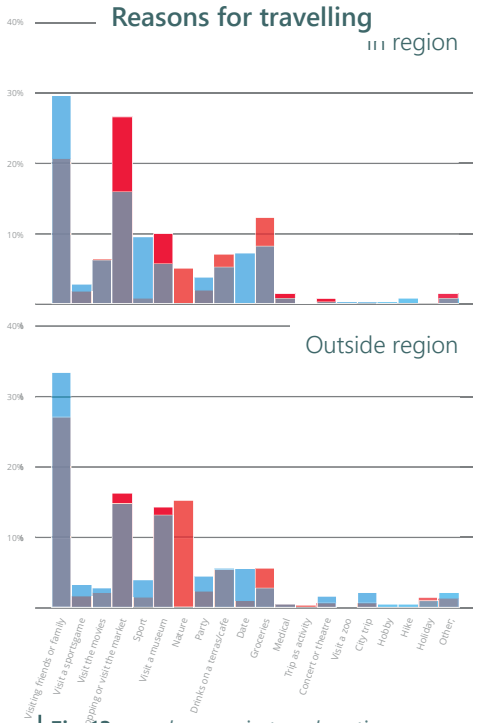


Fig 13 *graph on main travel motives for travelling to leisure activities*

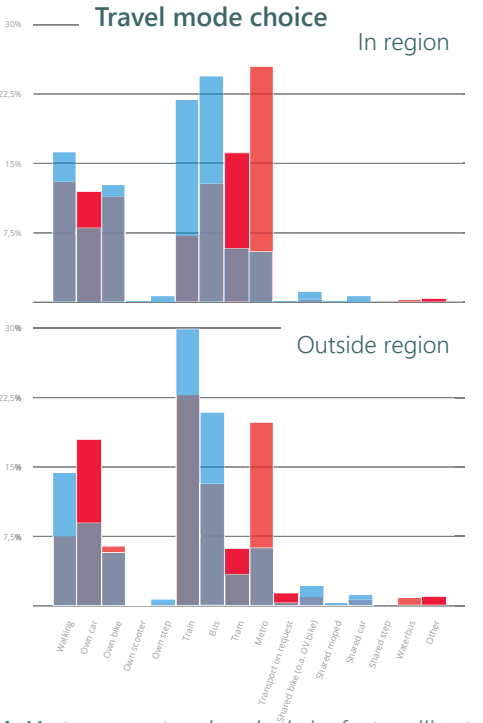


Fig 14 *Most common travel mode choice for travelling to this leisure activities (chosen in previous question*

Besides, 60 out of 80 respondents of 9292 indicate to travel with at least one public transport mode within their region, of which almost all (58 = 96,7%) also indicate to travel with public transport outside their region. 133 out of 231 RET respondents indicate to travel with at least one PT mode within their region, of which 124 (93%) also indicate to travel with PT outside their region.

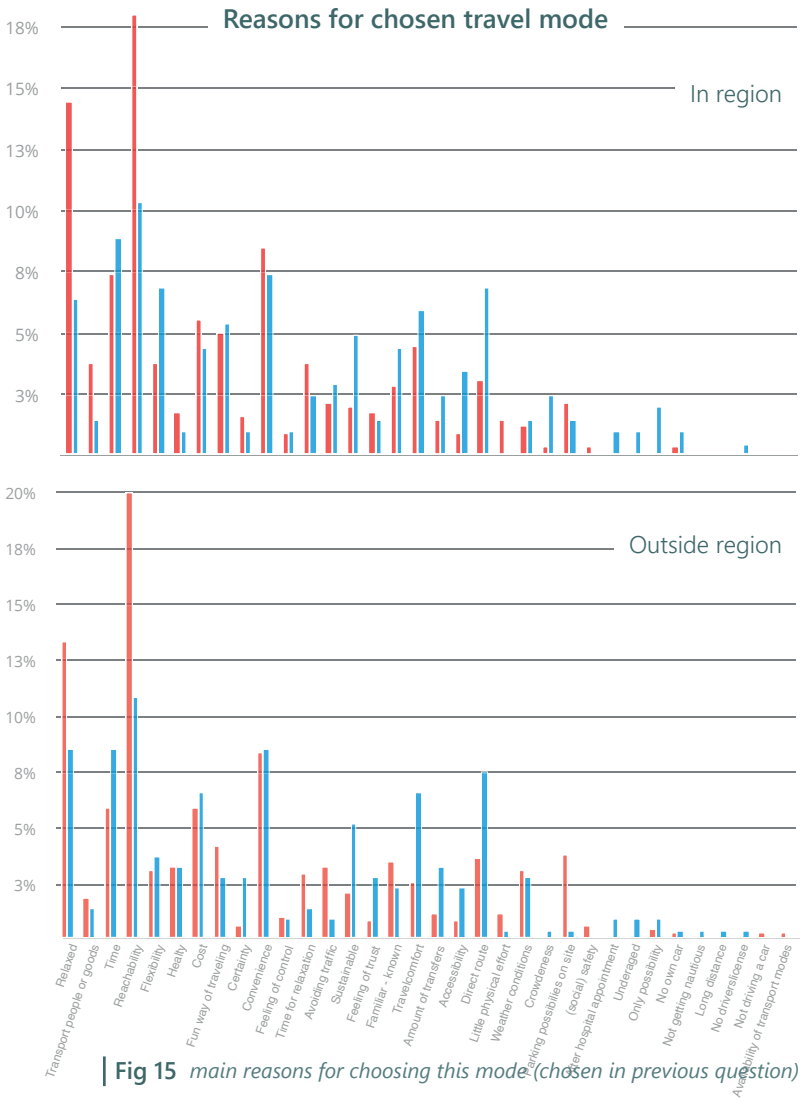


Fig 15 *main reasons for choosing this mode (chosen in previous question)*

Main insights

Main reasons for travelling to leisure activities are to visit friends and family and for shopping. Outside the region a visit to a museum or nature is for many respondents a reason to travel for leisure activities as well.

Respondents make little use of 'new' shared mobility services. Walking, public transport as well as own car and bike are travel modes often chosen when travelling to leisure activities. Compared to 9292 respondents, RET respondents use the car outside the region more. For 9292 respondents the bus and train are main public transport modes both inside as outside the region, whereas for RET the metro and tram are commonly chosen PT modes within the region and train and metro for trips outside the region.

Most respondents that commonly travel by car for leisure activities, do so both inside as outside the region. Whereas the same goes for respondents commonly travel with public transport.

The main reasons for respondents to travel by means of their three commonly used modalities has to do with **reachability** of the location, **convenience** and as they experience the mode as a **relaxed** travel mode. For travelling to leisure activities outside their region, **time and cost** also play a role for mode-choice.

Discussion
As respondents are recruited from 9292 Beta test panel and RET panel, there is a selection bias present. The fact these people are a panellist indicate they are already willing to support public transport involved companies. This then might impiy they are in general ambassadors of public transport.

Main goal

Gaining insights in in-depth latent needs and experiences from travellers that travel to leisure activities (Sanders & Stappers, 2012).

Main activities

As an introduction, different creative techniques are used to make participants comfortable and in a creative mindset that is not too focussed on the restrictions participants were currently facing due to effect of the Corona pandemic. Secondly, a laddering technique is used to elicit goals and underlying values for travelling to leisure activities as well as for travelling with that specific travel mode. Finally, two different scenarios for travelling to a leisure activity were provided and participants were asked to detail this into a door-to-door journey. The session concluded with a discussion regarding these scenarios to explore reasoning more in-depth.

Amount of respondents

Total of 6:
1 from own network, 1 RET, 2 9292
3 males, 1 female, age: 23-70ish, 1 car possession, 2 known to be living in a big city

Due to two last minute cancellations, the creative group session eventually consisted of four participants.

More details

The full questionnaires and results could be found in Appendix 13.2

Creative session /

Main results

Ladders of abstraction
From the different ladder exercises, different universal needs are discovered regarding carrying out the leisure activity itself as well as the travel mode choice to get there. These results are shown below.

Journeys from provided scenario
The provided scenarios are presented in Figure 16 and 18, the created journeys in Figure 17 and 19.

Travel scenario 1 "A city trip to a city unfamiliar and outside of your region"

Je reist alleen vanaf je huis in buitenwijk van Rotterdam

Je gaat de hele dag op pad met een vriend(in) die je en in Nijmegen ontmoet

Het is de hele dag al hartstikke warm

Je wilt lekker genieten van het weer, de stad ontdekken en het museum bezoeken

Na een diner in een restaurant wil je pas weer naar huis

Fig 16 *Scenario 1 provided in creative group session*

"I want to go on city trip to (unknown city) Nijmegen"

Needs for carrying out the leisure activity:

- Need for stimulation and novelty
- Need for relatedness
- Need for competence *(skill progression)*

Universal needs regarding mode-choice:

- Need for autonomy *(self-determination)*
- Need for ease

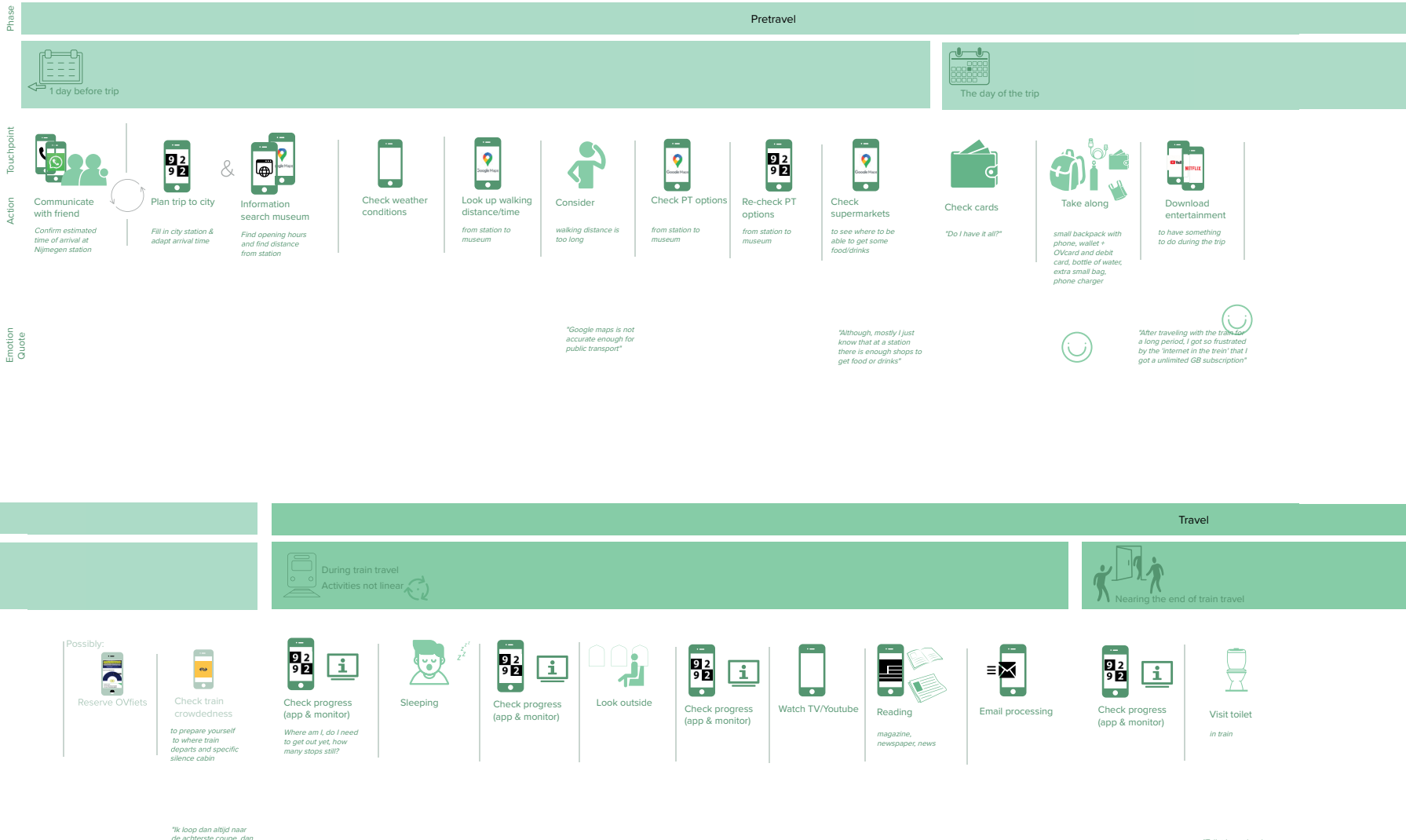


Fig 17 *Results of journey from scenario 2*

Arrival at final train station

Travel to museum

Possibly:
Visit toilet

Communicate with friend

to find each other

Possibly: share live location

Get saved travel advice

in personal (google) agenda

Consider

if this trip is still matching current needs

Walking

with OVfiets

if friend is by bike

with PT

if bad weather

"Als ik eenmaal een OVfiets heb, dan ben ik gierig genoeg om ook de rest van de dag de OVfiets te gebruiken, ook al regent het"

"Als het weer slecht is, zou ik meer het OV gebruiken en minder wandelen"

Phas

Travel home

Prepare

Travel back home

Touchpoint

Action

Getting some food, saying goodbye

Same as outward journey

Eat dinner

in train

In train, less need to check app

to check trip progress

Preparations at home

e.g. put room temperature a bit up for when being home

Travel scenario 2 "Travelling to have dinner at a friend living in your own region"

Fig 18 *Scenario 2 provided in creative group session*

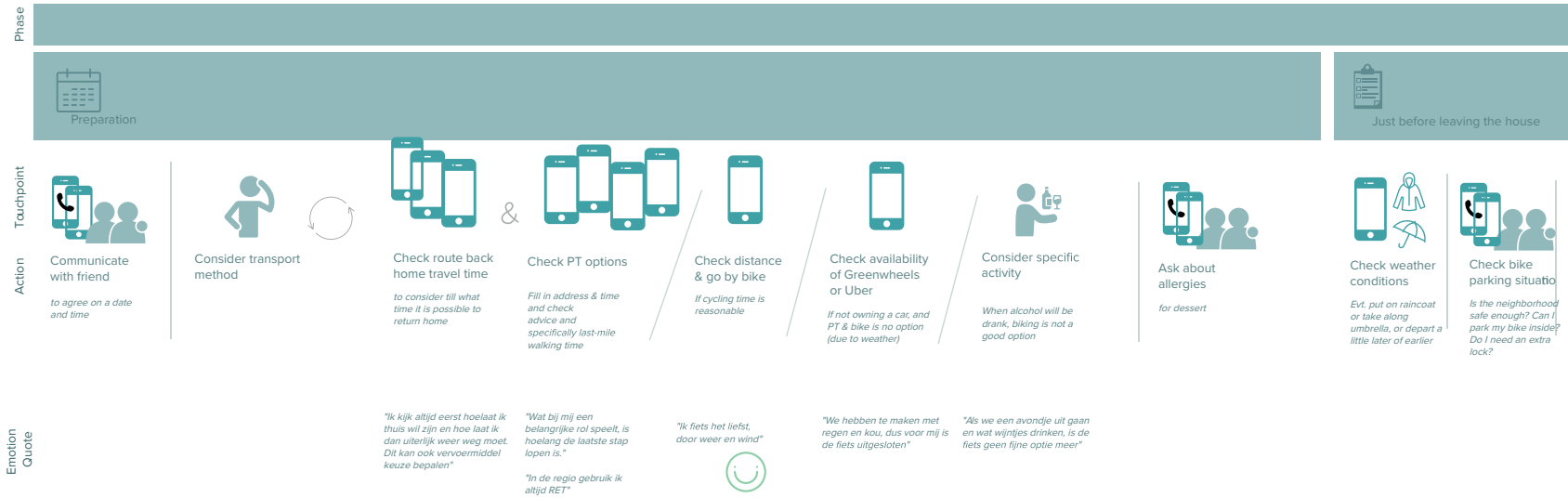
"I want to visit a friend"

Needs for carrying out the leisure activity:

- Need for relatedness
- Need for stimulation *(novelty, variety and fun)*
- Need for stimulation *(bodily sensations)*
- Need for mental stimulation

Needs regarding mode-choice:

- Need for security
- Need for morality
- Need for ease *(convenience)*
- Need for fitness *(physical comfort)*



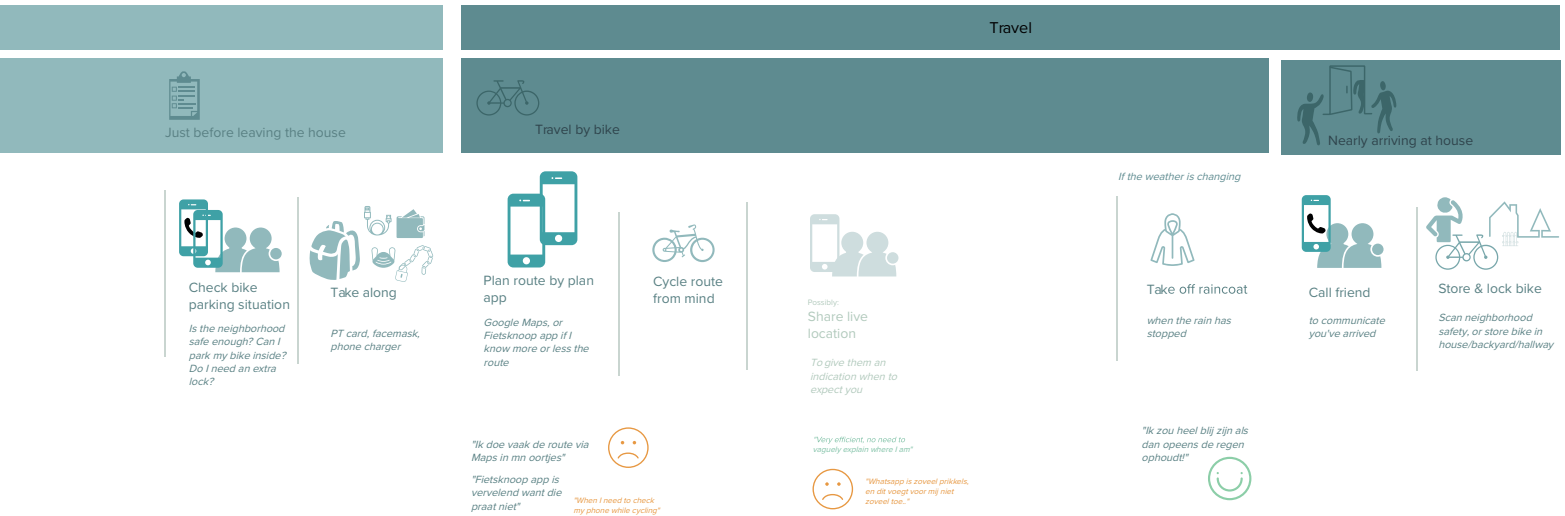


Fig 19 *Results of journey from scenario 2*

Main insights

Cross-checking

Results show participants often cross-check different mobile application during the entire length of their travel process. This cross-checking is carried out to find ‘the best’ method to reach the desired destination and is done prior to the actual trip (pretravel phase), during the trip itself as well as after one part of the trip. What is considered ‘the best’ depends on the type of trip, travel goal as well as the (changing) current context.

It’s a city, so there is probably a bus and a train towards this location

- P3, creative group session

Drivers for mode-choice

Mode-choice might depend on specific transport needs, but even so mode choice is highly based on habits. Travellers ‘know’ and are familiar with a set of ways to travel and use mobile applications to consult and check these options they already have in mind. Especially in their own region these ‘known-travel modes’ are very acquainted. Once travellers don’t know the possible travel options, which might be the case when travelling to a city one has never been before, mode-choice is very much based on assumptions of what these options are.

This way of travelling is for me good enough, so why change?

- Informal conversation with a friend

Cost plays a role in the sense that it supports to fulfil a (universal) need for travelling. Respondents see no need in changing their common travel mode-choice once their current travel method serves their main needs to an extent that they feel is acceptable.

Multiple travel plans serve as parts of a whole

Door-to-door planning is not the common method to plan a trip. Especially when meeting a friend halfway the journey, the trip is planned in different parts by creating a travel plan per ‘part’. What this ‘part’ is, is depending on priorly known or simply assumed convenience and might be decided in consultation with travel company.

Main goal

Discover in-depth insight into the travel needs and drivers for mode choices, by exploring a broad range of travel experiences while being in the necessary process of changing existing travel habits.

Main activities

Diary studies are carried out throughout the length of the graduation project in which different journeys are elaborated when travelling to leisure activities both within as outside of the region of Rotterdam, both with and without the company of the new dog and/or partner.

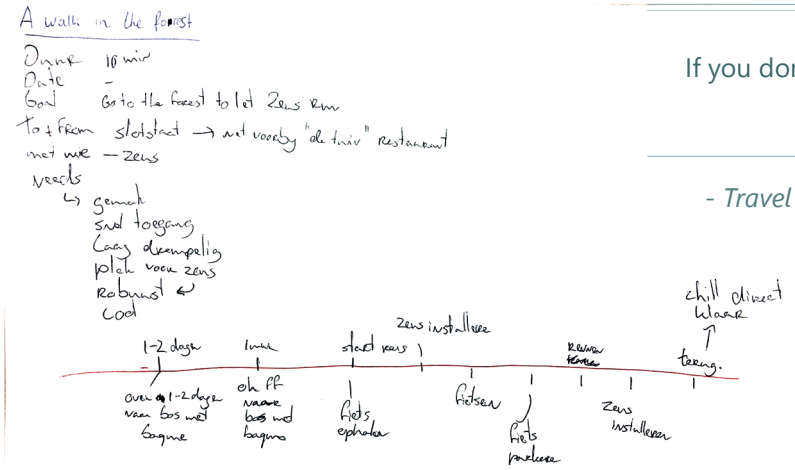
More details

Full session setup, results and conclusions could be found in Appendix 13.3

Diary studies /

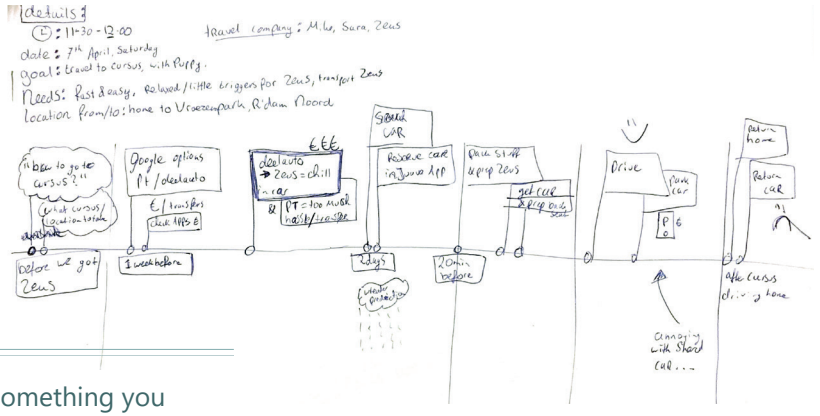
Main results

A selection of these simple sketched out journeys are shown below.



If you don't know about it, you can't use it

- Travel partner, diary study discussion



[planning a trip] is something you don't want to invest time in. It's such a simple thing, but essential

- Travel partner, diary study discussion

Fig 20 & 21 *Examples of diary studies*

Main insights

It became apparent that travel drivers are affecting mode-choice and route choice. And when travelling this new travel company (with a puppy), the main travel needs and the specific way these needs are expressed changed. For example, whereas cost and travel time used to be the main reasons for choosing a route and travel modes, the level of (expected) comfort and freedom when travelling with the dog became to outweigh time and cost.

Apart from the fact that some travel modes are simply not possible anymore when travelling with a puppy or dog, like a bike, new and very specific needs for travelling developed. For example, the maximum amount of time in a specific modality (like a train), but also walking time and the number of transfers became of high influence.

Besides, the way a travel need is expressed and fulfilled changed as well. What used to be a comfortable way to travel, like a train, simply not experienced as comfortable anymore. Rather, a car became the most comfortable travel mode as the dog was very used to travelling in this mode and immediately fell asleep.

In line with discovering these 'new' needs, there also grew a need to explore or broaden the set of commonly used travel-modes. Current 'known' travel methods were simply not fulfilling these new travel needs enough. Living in the urban area of Rotterdam, many different 'new' mobility services were at disposal.

Trying out these new services was interesting and experienced as fun. Although once the 'newness' wore off, service 'bugs' led to frustrations. For example, not being able to lock a modality causing to paying more than needed is generating frustration at the end and an overall negative post-purchase evaluation. Also, finding new alternatives and learning about their opportunities could be challenging. Finding information about all possible travel offerings was not provided via one platform, causing a need for actively searching and putting in quite some effort and time. Evaluation of alternatives also proved to be challenging. For example, there are a few different shared mobility services in Rotterdam, although finding all these was not effortless. Besides, figuring out how each service works and how their pricing is structured, appeared to be quite a complex and time-consuming process.

It takes time to find a travel mode that matches these new and specific needs. This causes the planning process to be more elaborate and time consuming. It also made it necessary to plan a trip earlier in advance, which is generating some frustration due to a decreasing sense of freedom and spontaneity. Besides, the planning process itself takes more time as it becomes necessary for consulting different applications of different mobility service providers as well as planner applications (like 9292 and Google Maps). It shows a growing desire for an easy and not time-consuming process of choosing a travel method.

4.4 The traveller
that travels to incidental leisure activities

The previous subchapters describe the activities and research carried out to scope a specific target group and unravel their current experiences when travelling to incidental leisure activities. This subchapter serves as a conclusion about this target group by summarizing the true needs, current experiences and drivers of travellers travelling to leisure activities.

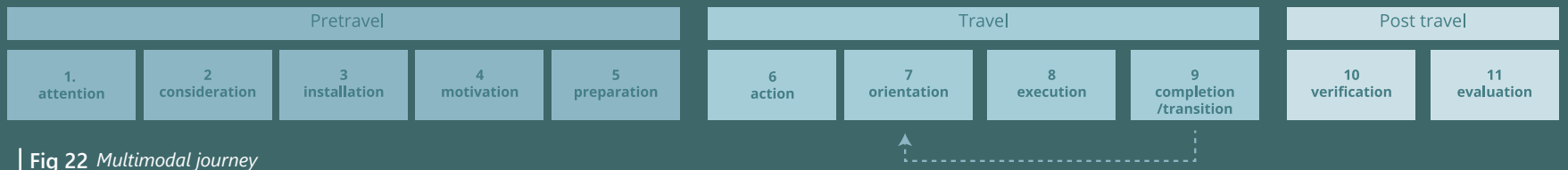


Fig 22 *Multimodal journey*

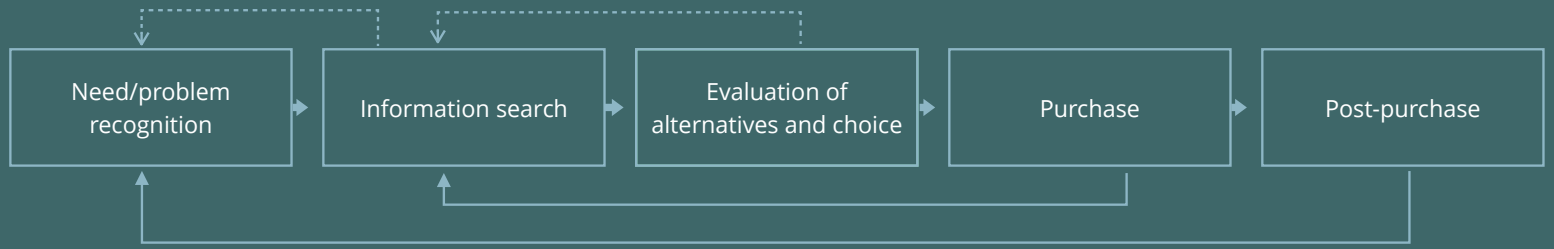


Fig 23 *Five stages of consumer decision-making (Dewey, 1910)*

Multimodal travel process

The core of a MaaS concept is that it allows for making multimodal trips, in other words a trip in which different modes of transport are utilised (Durand et al., 2018). There are different phases a traveller goes through when travelling from A to B. In line with research by Joppien, Niermeijer and Niks (2013) and Kuiper (2020), the multimodal journey is considered to consist of thirteen steps that are part of three phases: pretravel, travel and post-travel, see Figure 21. As this model shows, travelling also entails the purchase of an offering. John Dewey (1910) introduced five stages a consumer goes through when considering a purchase of an offering, see Figure 22; 1 Problem or need recognition; 2 information search; 3 evaluation of alternative; 4 purchase; and 5 post-purchase evaluation

(not)Driven by habits

Once a decision is made to undertake a leisure activity, travellers have to make choices on when to travel, what mode(s) to travel with and what route to take. Research shows these choices are in stable contexts highly driven by habitual decision-making (Durand et al., 2018; van Hagen & Exel, 2012). Charles Duhigg (2013) describes the human habit in the form of a looping process: "Habit loop process". This process has shown that habitual buying reduces consumers' consideration for other products. People are creatures of habit, and these habits are formed as our human brain is constantly looking for ways to save effort. Habits help us to stop thinking about basic behaviour and thereby 'save space' which allows us to focus on the more important things. Not only do we form habits to help us save

Cross-checking applications

Cross-checking different plan applications is done to find 'the best way' to travel. Personal judgements and values affect what travellers consider to be the 'best' for them, and these considerations differ and depend on the goal the traveller aims to have fulfilled. These (mostly) mobile applications are not necessarily utilized to seek travel plan advice, but rather to consult or check own ideas.

(re)consideration of travel method

The moment current travel habits are not fulfilling one's specific travel needs anymore, the travel mode choice and route is (re)considered. Key or life events can trigger changes in travel behaviour(Lanzendorf, 2003), which is for example the case when there is a change in travel company or possession of travel modes. But also, when travelling to destinations of unfamiliar locations where one is completely not aware of the possible travel options, and when one has specific but uncommon needs like transporting furniture. In this consideration and decision-making process, information search and evaluation of alternatives is carried out by means of cross-checking different applications. This activity is carried out both prior to a trip well as during the trip itself.

Tension model for travellers travelling to leisure activities

Although mode-choice is based on habits, the conducted user research shows that the choice for travel

If I go to [...] in Rotterdam, I have three options, either by tram, metro or waterbus

- P1, creative group session

mode(s) and route is also influenced by the specific drivers and needs a traveller aims to fulfil by or during that trip. Based on the insights elicit from research by van Hagen (2012), previous graduate research projects from Seamless Personal Mobility Lab (Goettsch, 2021; Hendrikx, 2021; Kuiper, 2020; Rikken, 2016) and the conducted user research within this project, the needs and drivers for travellers that travel to incidental leisure activities are discovered.

These drivers and needs are mapped in the form of a tension model, by which need segments are formulated (Koos Service Design, 2021). These need segments represent different groups of travel needs a traveller can have when travelling to leisure activities. They are created to structure the gathered user research data and supports to empathize with the traveller. The model serves as input for designing.

The model identifies six key motivations which represent emotional drivers of travellers when travelling to leisure activities. These drivers influence each other and are mapped on three axis of 'tension'.

When analysing the results much overlap could especially be found with previous research of a graduate student of the Seamless Personal Mobility Lab regarding Air-rail travellers (Hendrikx, 2021). Therefore, the tension model on "Air-rail travellers" formulated by Hendrikx is taken as a base for composing the tension model of travellers that travel to incidental leisure activities which is visualised in Figure 25.

Getting from door to door v.s. Trip as part of leisure

The horizontal axis shows the tension between the driver to 'getting from door-to-door' and 'trip as part of leisure'. One time a traveller just wants to reach the leisure activity with as little difficulty as possible, the other time the trip itself is already (part of) the recreational outing itself.

Do it my way v.s. Relying on the service

The left vertical axis shows the tension between the drive 'to do it my way' and the drive 'to rely on the service'. One moment you want to mainly be in control yourself and strive for autonomy, the other moment you rely more on the service and desire guidance and support by the system.

Explore the freedom of mobility v.s. Know where I stand

The right vertical axis shows the tension between the desire to 'explore the freedom of mobility' versus 'to know where one stands'. At one moment your drive is to explore and experience the freedom mobility has to offer, and the other moment you want to be informed and certainty of where you stand.

On these axes of tension, a key set of the identified needs are plotted and clustered. This result in the formulation of six need segments. These segments are considered to function as a specific 'cap' a traveller put on depending on the specific needs that come with travelling to the specific leisure activity, and influences mode-choice and route.

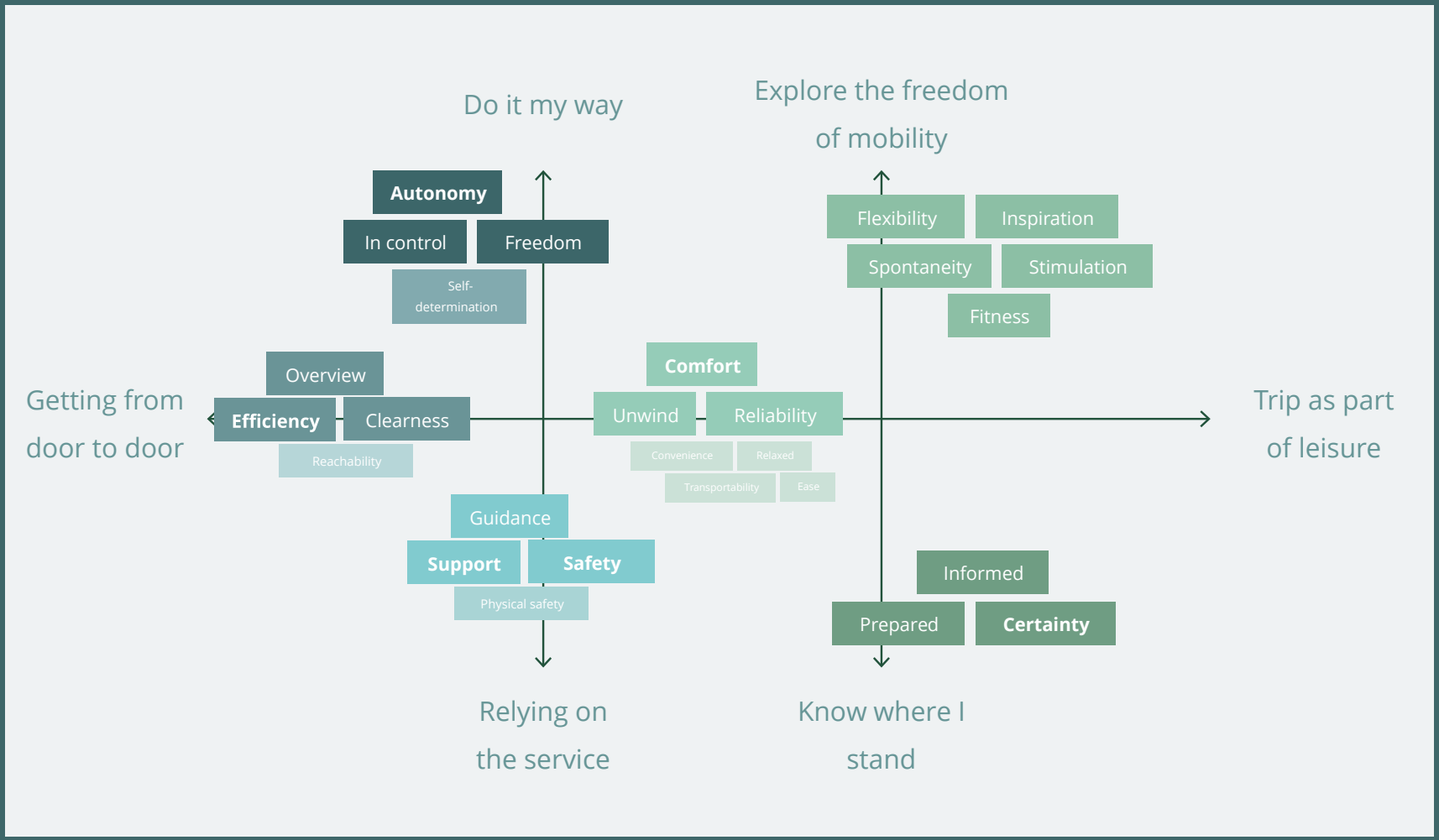


Fig 25 *Tension model for travellers travelling to leisure activities*

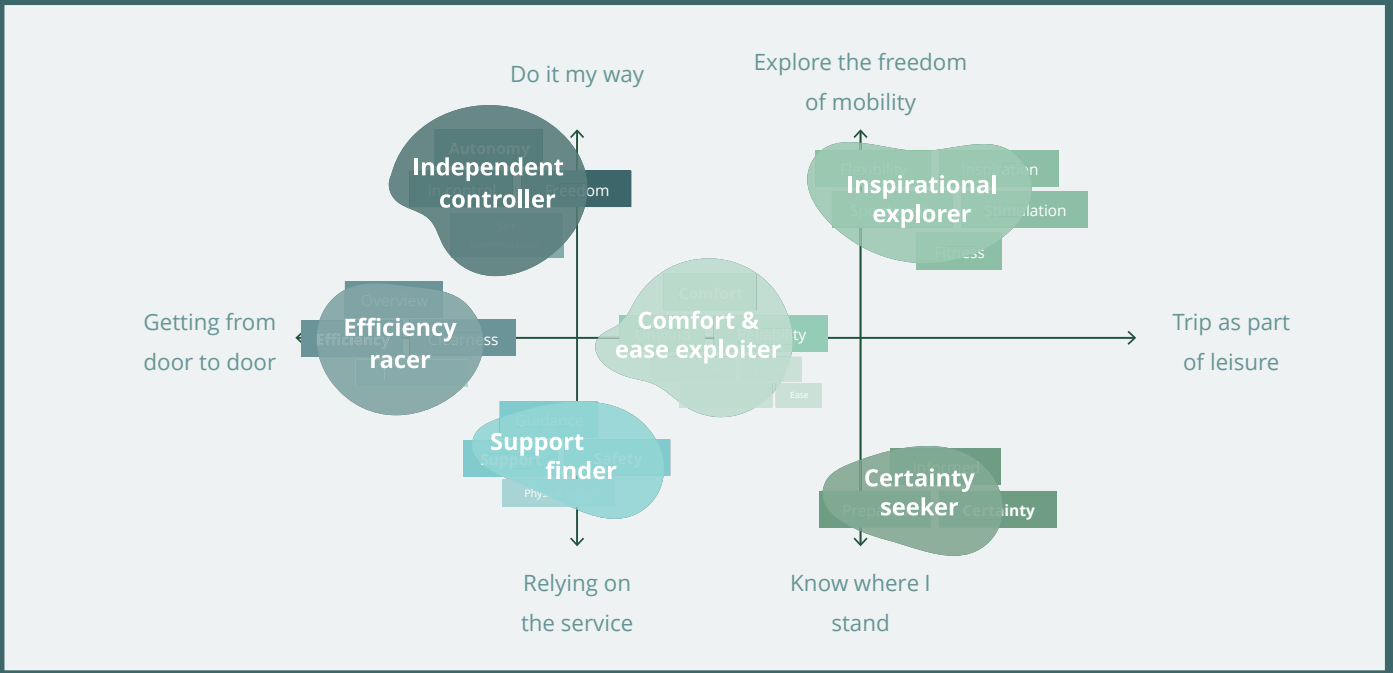


Fig 26 *tension model with travel need types*

Travel need types and scenarios

To make the knowledge in this model less abstract and support empathising with the target group on a deeper level, the need segments are renamed in traveller need types, see Figure 26: Efficiency racer, Independent controller, Support finder, Comfort & ease exploiter, Inspirational explorer and Certainty seeker.

For the remainder of the project the target group is scoped even more by focussing on one of these need segments as a case study. Given that travel needs like relaxed, convenience and ease were main results from the questionnaires as well as creative group session, the Comfort & ease exploiter was taken as a base. To illustrate how this travel need type could travel in a real environment two scenarios are drawn up. Consult Appendix 13.5 for the detailed version of the two scenarios.

These scenarios are about a girl, Lisa, living in an outskirt of Rotterdam and travels to reach leisure activities both within the region as outside of this region.

Scenario 1 is about Lisa travelling from her house in Rotterdam to the unknown city Nijmegen together with a friend, Anneke, for a city daytrip. During this Saturday, the two will enjoy the city, visit the Valkhof museum and do some shopping. They will enjoy a full day, from morning till dinner. The main characteristics of the trip are the desire to travel comfortably and together for the most part of the trip, and the both the city as the possible transport modes in Nijmegen are unfamiliar for both women.

Scenario 2 is about Lisa travelling from her house in Rotterdam to a friend. Joris, in Rotterdam, Noordereiland. She will spend the evening there, have dinner together to celebrate Joris' new job, The dinner is planned on a normal weekday: she will depart after her working day is over and will not make it very late at night. The main characteristics of the trip are her need to bring a bottle of wine and a self-made desert, and the region is very familiar for Lisa.

Fig 27 *Scenario 1*

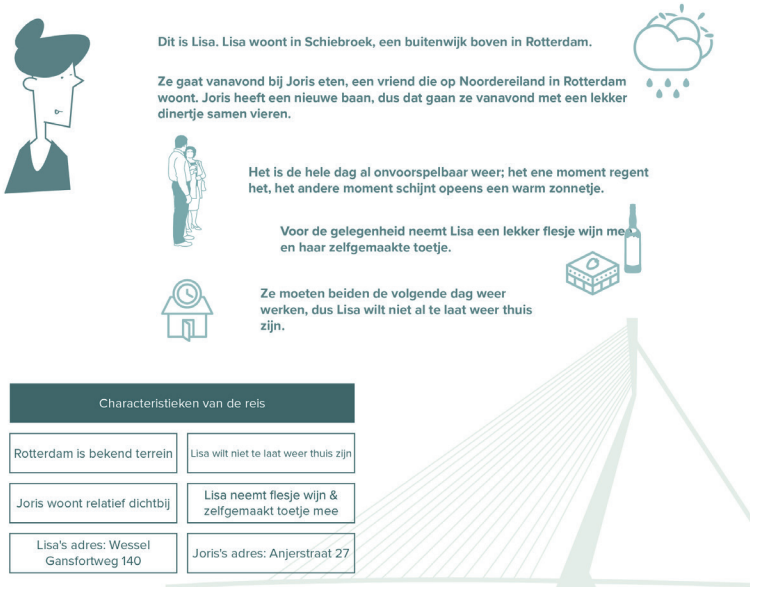


Fig 28 *Scenario 2*

Design

BRIEF

This design brief embodies

the conclusion of the research phase. In this brief the problem definition is discussed, followed by a mission and vision for the design and concludes with the formulation of the design goal within a clear moment of human-service interaction.

This brief serves thereafter as a starting point of the design phase.

5 Design brief

Main chapter insights

For MaaS to become a success, it should provide added value for travellers to adopt the service and stimulate a positive travel behaviour change. Currently the way people travel is very much rooted in existing habits and routines. Cross-checking multiple application is carried out in search of finding the best travel plan fulfilling travellers' specific travel needs. To improve this process of planning a trip, this project aims to support travellers in their information search on travel possibilities and evaluation of these alternatives.

Therefore, the goal is set to design a MaaS application that supports individual travellers with tailor-made travel advice to fulfil their trip-dependent needs, when preparing a door-to-door travel plan for travelling to leisure activities.

It’s not about me telling what colour matches their skintone. It’s rather about making them see what works for them

- Maaike van Meenen (9292), *brainstorm session*

5.1
/ Problem definition

For MaaS to become successful, travellers have to adopt the use of the service and it should persuade travellers into more societal desirable travel behaviour. In line with The Diffusion of innovations theory (Rogers et al., 1971), different qualities have to be present for a service to be adopted. Besides, the service should add value compared to travellers' current travel solutions.

In search of finding an added value MaaS could provide travellers, carried out research discovered some negative experiences during different moments in the travel journey. Moments that are truly experienced as negative, are mostly inconveniences that are mainly caused by the diverse respective mobility provider, service or transport mode. For example, frustration is expressed when a shared bike or moped cannot be locked or paused during a trip due to connection issues causing a traveller to pay more money than needed (insight by one of the diary studies in Appendix 12.3). Negative experiences are also expressed when a toilet on the train station cannot be found or when external weather conditions cause someone to run late and getting totally soaked (insights from creative group 12.2).

These issues could be aimed to overcome or even solved to ensure MaaS could provide an overall better user experience. Although the research also shows that once travellers encounter such issues, they generally find a way to solve the issue or overcome it themselves. Besides, I don't believe solving these elements will 1) make a traveller adopt MaaS, 2) make a traveller change current travel behaviour into behaviour that supports solving societal issues. In addition, the current parties this graduation project is a collaboration with, could only solve small elements of these negative travel journey experiences.

The research also shows travellers have a desire for finding the 'best' method for their trip. What is considered as 'best', highly depends on personal considerations and values that differ and depend on the goal the traveller aims to have fulfilled. Finding and choosing this 'best plan' is currently done through searching for information and evaluating different alternatives by cross-checking different (mobile)

> I always get so annoyed that the information boards on the train don't indicate the desired station travel information when the train is approaching a station... [when this happens], I use the 9292 app again to check my progress of the journey
>
> - P3, *creative group session*

applications during different phases of the trip. This activity of cross-checking may put travellers at risk of inducing a cognitive overload, which could lead to uncomfortable experience, frustration and comprised decision-making (Guerra, 2020; Halarewich, 2016; Sweller, 2011).

To help overcome societal issues, MaaS should ensure spreading travellers across the broad range of mobility offers as well as stimulating a less car-oriented lifestyle. Although, the research carried out within this project showed that the current way people travel, even though for leisure trips and to unfamiliar destinations, is very much influenced by habits. You could say that most travellers are rusted into their own travel behaviour. As is common with the process of solving societal issues, the consequences of societal issues are not that tangible, visible or directly of influence on the individual traveller (Durand, 2018). Why change current habits if these habits are experienced as positive (enough)?

On top of that, the way conventional plan applications are currently designed cause travellers to remain stuck in these travel habits. Such apps are focussed on providing a wide range of travel suggestions in which travellers can (amongst others) filter on specific travel modes. Currently, such apps are commonly used as a 'tool to check own preferred travel modes'. The initiative on how to travel and where to travel with lies completely with the traveller himself. Likewise, the initiative to 'travel differently' will also lie completely with the traveller.

> If I see that there is a potential public transport option in Google Maps (not too long or cumbersome), then I will enter the same route in 9292 to find a better public transport option
> -Yes indeed, I recognize that as well
>
> - P3 and P4, *creative group session*

Moreover, if for whatever reason, a traveller however wants or needs to search for alternatives to accustomed travel methods, current planners support their decision-making process of searching a trip that 'works best' very little. The activities of information search and evaluation of alternatives are currently complicated. Finding information on the entire range of possible mobility offerings within a specific location and recognize what added value they might provide is cumbersome. It is a lot of hassle, time consuming and even necessary to consult several different applications and platforms. In carrying out these activities the initiative and effort rest entirely with the traveller. On top of that, as discussed before, the need for cross checking multiple applications could induce a cognitive overload which could comprise their decision making and might lead to uncomfortable experience and frustration.

5.2
/ Vision and mission

The current way people travel, even though for leisure trips and to unfamiliar destinations, is very much influenced by habits. Even though travellers experience current way of travelling as 'fine', current services ensure travellers will also remain stuck in these habits. To solve societal issues, researchers express it is essential to generate a certain change in travel behaviour and mode choice and spread mobility across a range of all possible modalities.

By enhancing travellers' search of finding the 'best' travel plan, a MaaS application could provide added value in supporting travellers' decision-making process. Whereas with current planner services the initiative and control on how to travel is completely in the hands of travellers themselves, I believe this moment of planning could become a window of opportunity in stimulating behaviour change. Research shows that apps could impact travel behaviour, thanks to the wide-spread adoption and pervasive use of mobile devices and applications (Durand et al., 2018). Besides, a pilot research shows potential in nudging travellers into more sustainable travel mode-choices during route planning activities (Anagnostopoulou et al., 2020).

For this, I believe the role of a planner should shift from using a

'planner as a checking tool of own preferred modes'

to a

'planner as an inspiring personal assistant of all possible travel options'

By providing travellers with inspirational, refreshing and relevant travel suggestions in line with their personal and trip-dependent needs, travellers could 'see for himself' what could work as well. It's about expanding one's wallet of potential travel modes. It's about stimulating exploration of 'other possibilities' that might provide meaningful new added values.

Therefore, the following goal for this project is formulated:

5.3
/ Design goal

What

Who

Design **a part of a MaaS app** that **supports individual travellers, travelling to leisure activities**, **when preparing a door-to-door travel plan** with **tailor-made** travel advice to fulfil their **trip-dependent** needs

When

How

| WHO: Travellers that travel for incidental leisure activities

Within this target group, the travel need type of "Comfort & Ease seeker" is taken as a case study for exploring potential and gaining insights. It is envisioned to lead to the discovery of a 'proof of concept' which could later be applied to other target groups and travel need types as well.

This case study is in the form of a scenario in which two travellers travel together to go on a city day-trip to a city they are both unfamiliar with. Their main needs are to travel in a comfortable way and travel together for social reasons.

| WHEN: preparing a door-to-door travel plan

The moment of interaction is when travellers are preparing a door-to-door travel plan in the pretravel phase of the journey. How people travel is grounded by existing habits and assumptions. During this planning step of the travel journey, travellers are in the consideration and decision-making process of how to travel and where to travel with, see Figure 29. Therefore, this moment might have potential to influence or persuade travellers into new ways of travelling. This is the reason this step of creating a travel plan is envisioned as a window of opportunity for behaviour change to happen.

| WHAT: part of a mobile MaaS application

As the user research indicates a mobile application is a touchpoint and medium travellers often use while planning a trip. Using a medium that is currently already used might be a promising strategy to promote behaviour change as this at least not adds another step to the process (Strömberg, 2015).

| HOW: supporting with tailor-made advice that fulfills travellers' trip dependent needs

In this journey plan process the traveller should on one hand be supported in creating a travel plan that fits personal needs, and on the other hand be triggered into more societal desirable travel behaviour.

For this travel suggestions should be personal and in line with the trip dependent needs. Meaning that it should be in line with a traveller's capabilities and provide interesting suggestions for the specific trip to be made (Kuiper, 2020; Rikken, 2016).

On top of that, the current control and choice of the traveller in how to travel and where to travel with must be balanced with a certain level of guidance on mode-choice by the system. It's about inspiring travellers and making them see what added value other ways of travelling could offer.

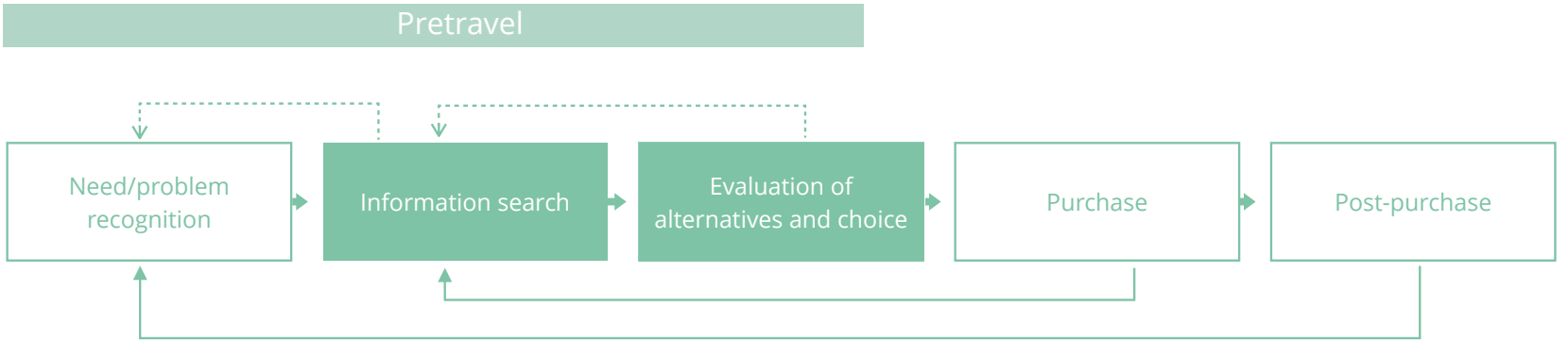


Fig 29 *Focus decision making process steps as part of pretravel phase*

Design

PHASE

This design phase is about

designing a solution for the formulated design goal. Different concept directions are explored by means of an iterative process in the form of sprints. Each sprint consist of ideation activities, prototyping, a test and an analysis.

This phase concludes with the formulation and elaboration of a final design, which serves as main focus for the subsequent evaluation phase.

6 Design process and methods

Main chapter insights

This chapter discusses in detail the design approach and corresponding methods that are used to iterate towards a desirable and usable final design concept. It could be consulted as a reference to understand how the results presented in the subsequent chapters are formulated.

Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning.

- Albert Einstein

The following chapter describes the different design research activities and methods carried out as part of the design phase. As it serves as a reference for the subsequent chapter in which results and insights gathered from these activities are discussed.

Sprints

To iterate towards a desired level of design and to keep up pace, the design phase is divided into 4 different 'sprints'. This process is inspired by commonly used processes in software development and is deployed to answer crucial questions through prototyping and testing ideas with users in a specific timeframe (Knapp et al., 2016).

Each sprint entails ideation activities, prototyping one or multiple prototypes, a test carried out with 6-7 participants, and an analysis. This analysis concludes with a formulation of a strategy for the next sprint. Each sprint is focussed on a different goal, with a different level of concept and prototype and concept fidelity. Likewise, the test setup is also different per sprint.

In this way it is aimed to ensure an in-depth and rich process with high user involvement that aims to deliver a potentially good design concept in a relatively short timeframe.

As is visualised in Figure 30, in each sprint and carried out test, different methods are used depending on the specific goals and desired outcomes. In the following paragraphs these different methods are explained per sprint main activity; ideation, protoype, test or analysis. This information will serve as a reference for further chapters.

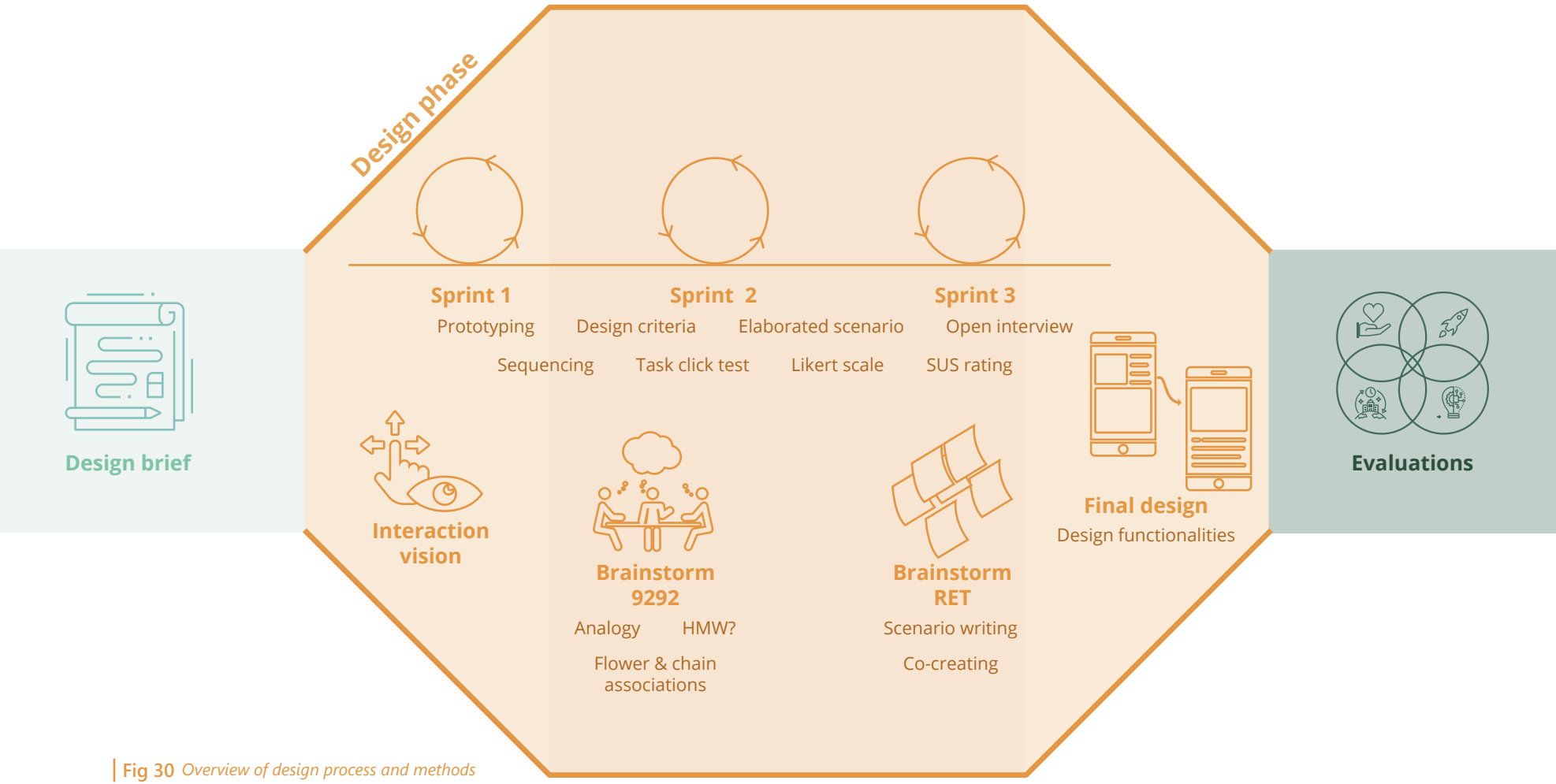


Fig 30 *Overview of design process and methods*

6.1
/ Ideation

Fig 31 *example of an analogy as part of a creative brainstorm*

Interaction vision

An interaction vision is a technique to generate and communicate interaction qualities and supports in transferring these qualities to the actual design context. By identifying an event unrelated to the context that is being designed for, and creating a rich representation of those experiences, the technique helps to identify a vision for the interactions the user should have with the future product (Pasman et al., 2011).

In this project it serves as a metaphor to gain inspiration from a different context and apply its elements as input for ideation.

Online brainstorm sessions

Different online brainstorms are done with a diversity of colleagues from the three collaborating parties of this graduation project. The brainstorm sessions were carried out in an online setting via Zoom and brainstorm tool Mural. In general, they took between 1-2 hours and were facilitated by the researcher herself. Within these sessions, different creative techniques were used. These will be discussed below:

Analogy
In this project, analogies are used as part of an online brainstorm session to generate options or ideas that go beyond the obvious (Heijne & van der Meer, 2019). For example, participants of a brainstorm session were asked to search for an analogy supported by a GIF that represents their specific desired feeling for travelling to leisure activities in the future. In this way inspiration is provided for the solving the design problem. An example of how such an analogy is used to spark creative ideas is visualised in Figure 31.

HMW questions
How might we questions are used to generate creative solutions by exploring different ways to carry out a task within a specific context (Rosala, 2021). An example of how this technique is deployed is visualised in Figure 32.

Fig 32 *example of a HMW question during a creative brainstorm*

6.2
/ Prototyping

| Fidelity prototyping

Prototypes are created to gain user feedback and user insights throughout different phases of the design process. By prototyping and testing, the principle of "learning by doing" is used, which help to iterate design solutions and generate tangible evidence on which solutions can be formed (Stickdorn & Schneider, 2014). Per sprint, the fidelity, level of detail and the number of elaborated features in the prototypes vary depending on the goal of the sprint and desired outcome of the test (Sanders & Stappers, 2012). Prototypes are made with wireframing and prototyping tool Figma (Figma, 2021).

White screen
If a feature is not elaborated in a prototype, a 'white screen' is used to be able to navigate through the use flow. An example of such a screen could be found in Figure 33.

Fig 33 *example of a white screen*

6.3
/ Testing

Test participants recruitment
Research by Norman Nielsen Group (2000) shows usability research conducted with a total of five testers already discovers about 80% of the usability problems. Within more qualitative research techniques, a number of participant anywhere between five to fifty participants is mentioned to be adequate to reach saturation and redundancy (Dworkin, 2012). As the design process in this project consist of multiple testing rounds and given the timeframe of one day of testing per sprint, a total at least six participants is considered sufficient.

Participants are recruited from a pool of interested people, that is collected from the online RET panel, 9292 beta test group, the researchers own network and via an article in 9292's quarterly Magazine. These people have expressed to be interested in participating in a research on personalised travel planning by means of either a remote test, a one-on-one interview, or a creative input session. They are contacted about one week before the planned test by email, and selected such to ensure a diverse mix of gender, age, car possession and level of experience in travelling with public transport or shared mobility services.

Test setting
The tests are carried out remotely via Zoom during which participants share their screen so that interactions with the prototype can be observed. In general, each test took around one hour and is carried out with six to seven participants each.

Throughout the tests different methods are used to find answers in line with the desired goal of each test. These methods are elaborated on in the following section:

| Interactive click modelling with tasks

To ensures participants can get a feel for the overall concept, to get input on what use flow participants would expect for specific functionalities, and to discover usability issues, click prototype tests are carried out (Stickdorn et al., 2018). During these prototype tests, participants are asked to click through a prototype, either while provided with a few specific tasks, or simply asked to explore the prototype freely. They are asked and supported to think aloud for the researcher to learn about their rational.

These prototypes are provided by means of a link that is either the Presentation view of Figma, or a testing environment setup with Maze, and are opened in the browsers of participants' laptop or desktop.

When a test consists of multiple prototypes, the prototypes are named randomly so that no ranking bias could occur. For instance, prototypes are not called, prototype A; B; C, but “maan”, “roos”, “vis”.

Figma preview
The presentation view of Figma allows to preview and interact with designs by clicking through and interacting with hotspots created on the app screens (Figma, 2021). It could be considered as interactive images, that are linked by means of prototype connections. The Presentation view also allows to show the prototype in a device, see Figure 34.

Maze environment
This tool allows to run in-depth tests and generate usability data like task analysis, heatmaps, mis clicks, A/B testing, multiple path analysis (Maze, 2021). It provides a test environment by means of a link that participants can open in their browser, see Figure 35. It generates a test report once the tests are completed, which summarizes the main results in a clear overview.

Elaborated scenario

Scenarios are provided prior to the user tests and are aimed to engage participants with a specific scenario and context of travelling to leisure activities. Such

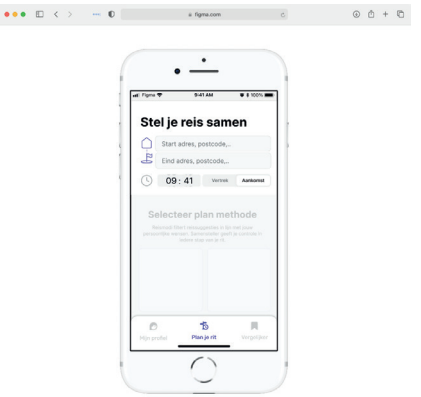


Fig 34 *example of Figma Presentation in browser*

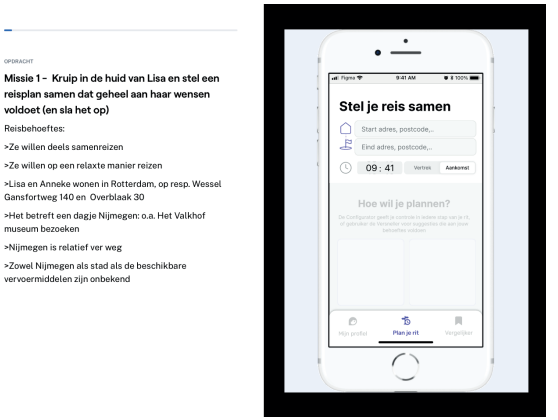


Fig 35 *example of Maze test environment*

real-world scenarios help them to place oneself in the user's shoes. It ensures all participants take on the same perspective and goals while going through the prototypes (Usability.gov, n.d.-a).

| Sequencing – comparing on two axis

To identify design criteria and to reveal and refine a problem and solution space, participants are asked to compare three different prototypes by mapping them on a matrix (Heijne & van der Meer, 2019). The two axes of the matrix entailed "I feel supported" v.s. "I feel I am on my own" and "I was provided with surprising travel suggestions" v.s. "I was provided with predictable travel suggestions". After positioning the prototypes on the matrix, the results and reasoning are discussed.

| Questionnaire

Questionnaires are used to discover perceptions, beliefs and preferences by testing degrees of opinion. The questionnaires were drawn up either with 5-point Likert scale to measure agreement or 5 emoticons ranging from negative to positive (Rosala, 2020).

| System usability scale (SUS)

To measure and evaluate the usability of different design prototypes, the System Usability Score (SUS) is used (Usability.gov, n.d.-b). It consists of ten questions with a 5-point Likert scale with options from Strongly disagree too Strongly agree. Based on research, a SUS score above 68 would be considered above average.

| Open interview

To allow for generating qualitative insights but not interfere with the participants' interactions during the prototyping tests, each test concludes with a short open interview. Questions are both structured as unstructured. On one hand, they are asked to discover some general insights on the experience of the design. On the other hand, this allows the researcher to verify or clear up any areas of ambiguity that is noticed during certain behaviour participant showed during the test (Sanders & Stappers, 2012).

6.4
/ Analysing

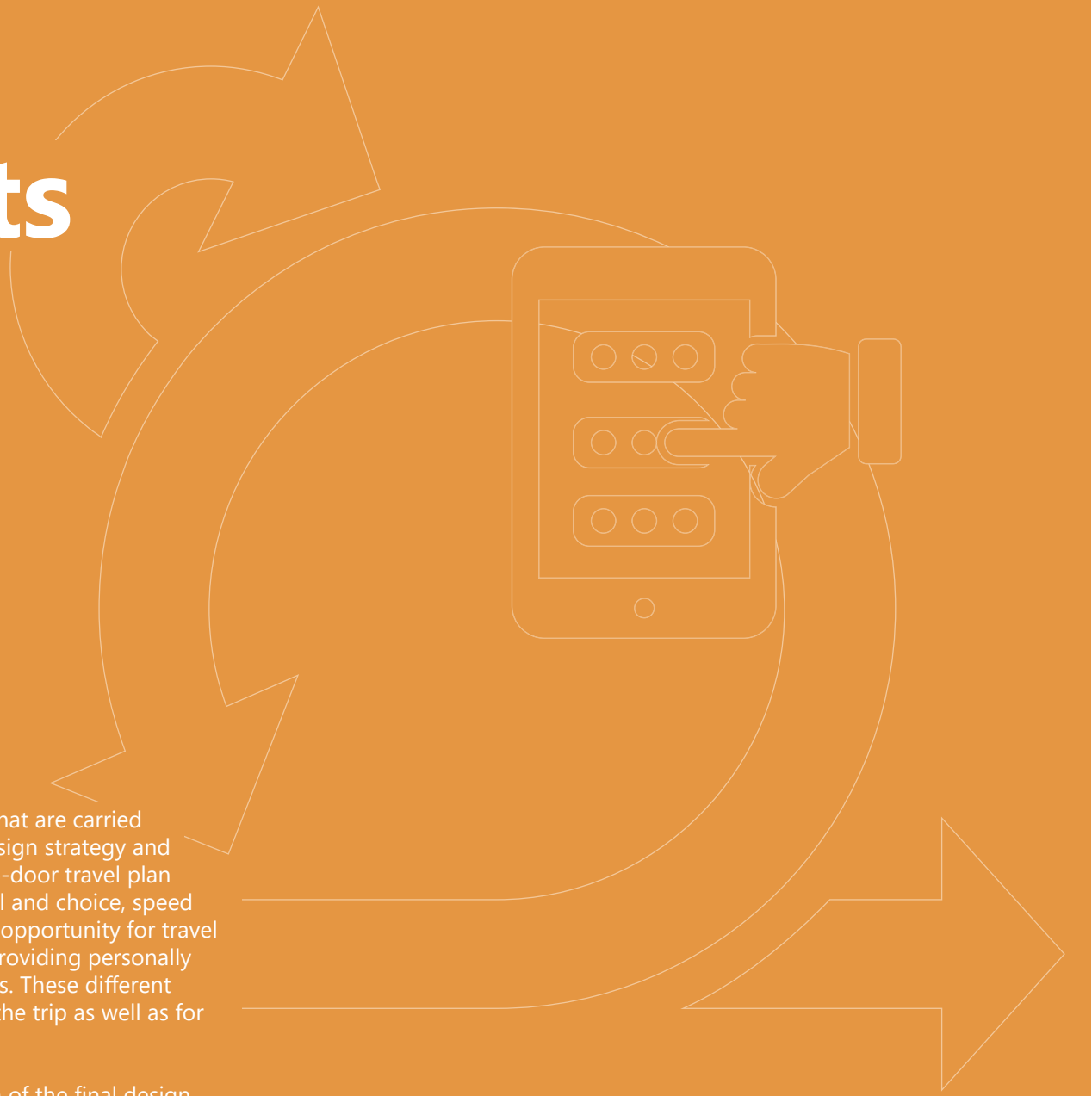
| Design criteria

Design criteria are explicit goals the design must achieve in order to be successful in fulfilling the design goal formulated in Chapter 5.3. These criteria are used as measures to evaluate the success of a design prototype (van Boeijen & Daalhuizen, 2013).

| Testable targets

To allow for measuring the success of a prototype during a test, targets are set in a measurable and testable way. These testable targets are drawn up from the design criteria and serve an important role in the overall setup of a test and the choices what user research method to use.

7 Sprints



Main chapter insights

This chapter elaborates on the different sprints that are carried out to discover and formulate design criteria, design strategy and functionalities. The process of creating a door-to-door travel plan should provide travellers with freedom of control and choice, speed and ease. The design should create a window of opportunity for travel behaviour change. This could be supported by providing personally relevant inspiration on a diversity of travel modes. These different modes should allow comparison on each leg of the trip as well as for travel plans as a whole.

Eventually, these insights lead to the formulation of the final design, which will be discussed in the subsequent chapter.

It depends on the purpose of the journey how I would like to feel and by what means I would like to travel

- Participant 6, *Test sprint 1*

Whereas the previous chapter described the process and used methods as part of the design phase, this chapter elaborates on the main results and conclusions discovered in the three design sprints. Within appendices 13.5 - 13.8 more detailed descriptions and results of each sprint can be found.

Each sprint entails ideation activities, creating one or multiple prototypes, a test carried out with six to seven participants, and an analysis. In this way an in-depth and rich process with high user involvement is ensured that delivers a potentially good design concept in a relatively short timeframe.

To ensure this iterative sprint process is effective and efficient, prior to its start, documents and participant recruitment structures are prepared. Besides, some initial ideation activities are carried out to support shifting the researcher's mindset from the more analytical research phase to the more creative design phase. An example of one of these ideation activities is the creation of an Interaction vision, which is illustrated in Figure 36.

What if creating a door-to-door travel plan feels like ...

finding a suit in a speciality store for a specific occasion

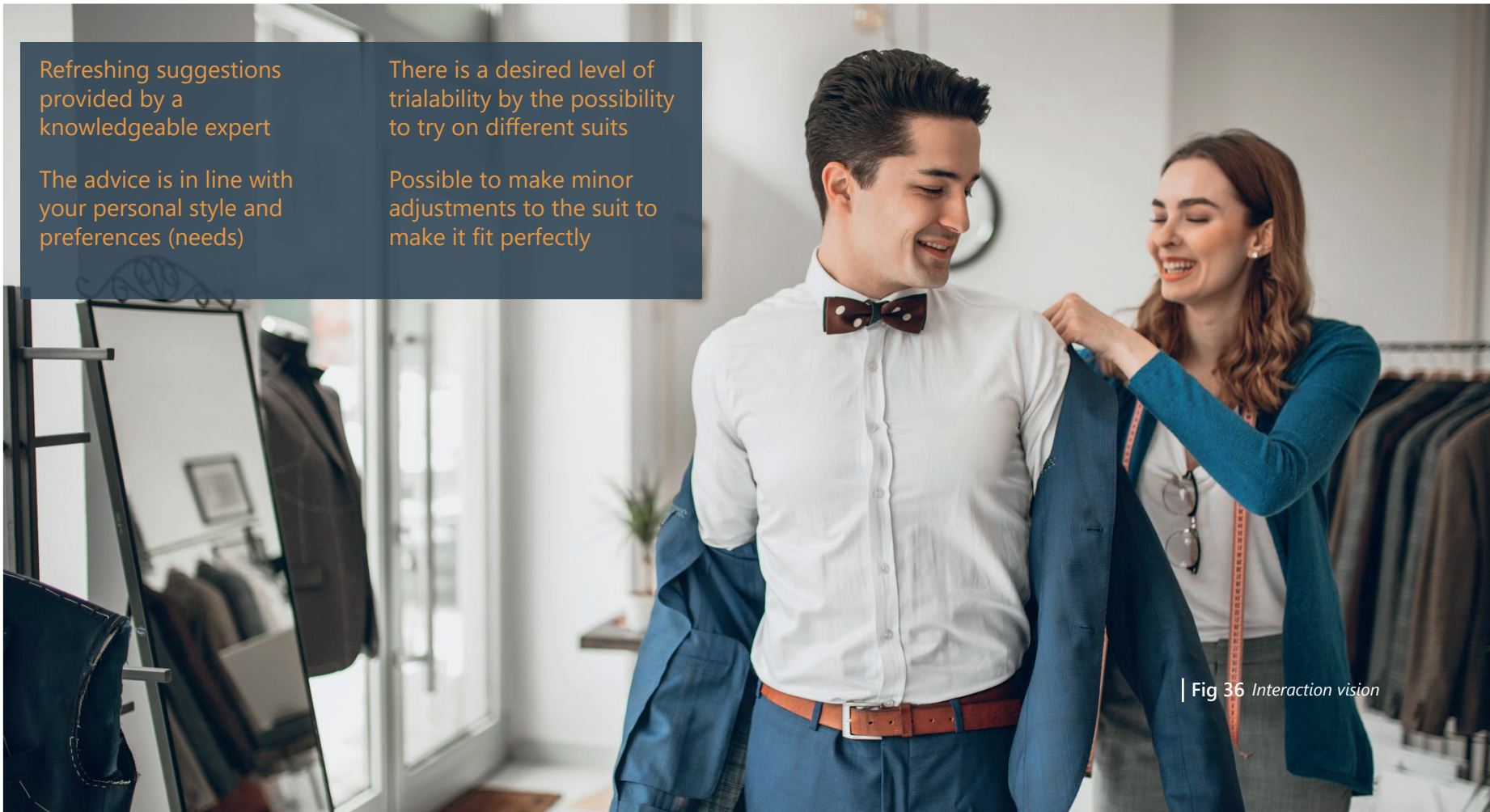


Fig 36 *Interaction vision*

Sprint goal

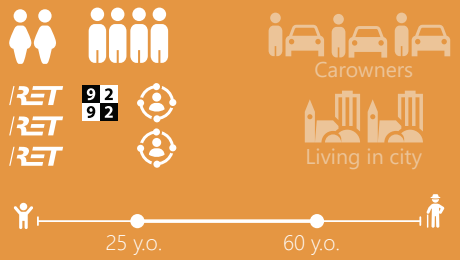
Explore directions for interaction concepts and discover design criteria to fulfil the design goal.

Main activities

Three distinct interaction concepts are ideated and prototyped to a level of fidelity so that the essence of the interaction could be experienced. These concepts are tested by six participants in a click-prototype and compared by a two axis sequencing.

After analysing the results, a strategy is formulated and design criteria are drawn up to meet the initial design goal.

Participants



Sprint duration

two weeks

More details

A full and detailed overview of this sprint, it's prototypes, test setup, results and conclusions could be found in Appendix 13.5

7.1 / Sprint 1

7.1.1 Concept and prototype

Ideation is done by formulating an interaction vision, brainstorming individually and with the team of 9292 on 'How might we' questions like 'How might we provide a person with suggestions in line with personal needs?' and 'How might we envision personal travelling of the future?'.

From here three distinct interaction concepts are ideated, with the main difference in amount of control the traveller has in creating the travel plan, and in the extent in which the use of 'trip- dependent needs' are reflected in the concept.

"Roos" concept

A chatbot-kind-of interaction in which questions are asked to learn about the traveller's travel context and trip-dependent needs. Details belonging to a profile are created and saved through asked questions by the chatbot. The system is in full control of forming the travel plan; after going through the chat-interaction, only one advice is presented.

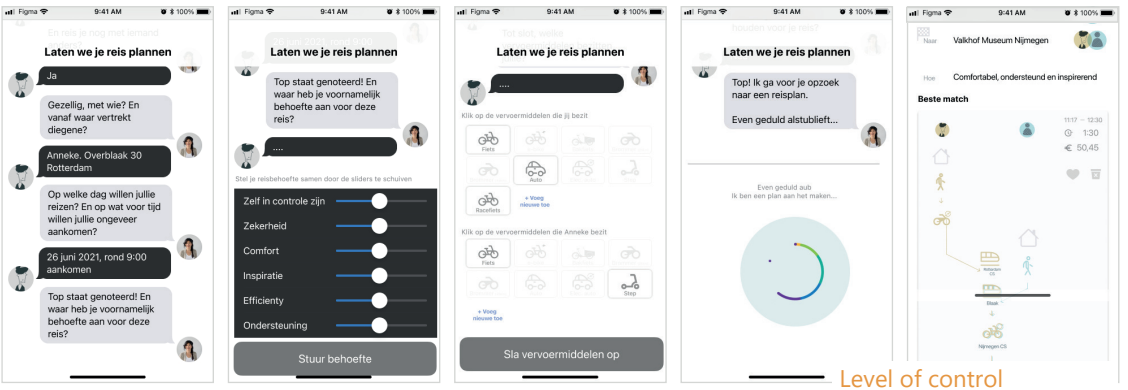


Fig 37 *Some screens to illustrate prototype Maan*

“Maan” concept

Based around a composer-interaction in which the traveller has full customization possibilities by choosing travel modes per leg of the journey. The options as well as the amount of legs the trip (should) consist of, depend on priorly chosen travel mode. The traveller is in full control. The idea is that a traveller creates the plan such that it matches his own needs; the system supports in the sense that it only shows possible trip legs.

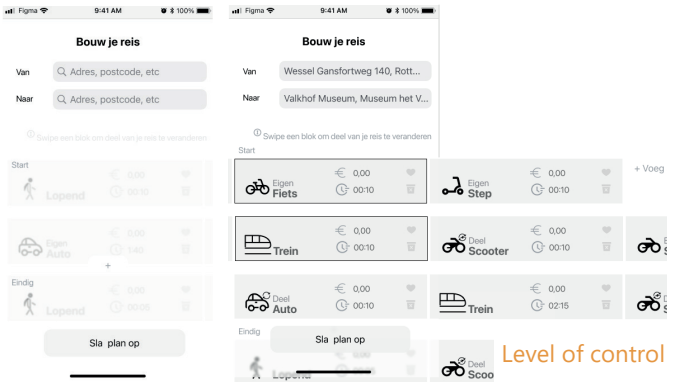


Fig 38 *Some screens to illustrate prototype Maan*

“Vis” concept

With the six travel need groups formulated in chapter 4.4 as a basis, this interaction concept starts from ‘pick your current travel mood’ and provides the traveller with four suggestions that are (according to the system) in line with this main mood/need. The traveller is control by making a mood choice and by choosing one out of four suggested travel plans. The system is in control on how the ‘moods’ are materialized in mode and travel plan suggestions.

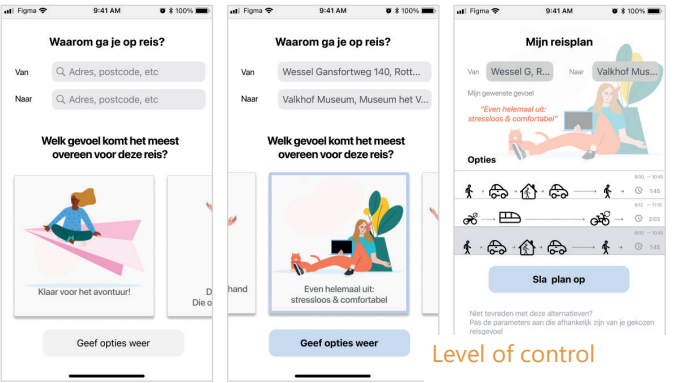


Fig 39 *Some screens to illustrate prototype Vis*

7.1.2 General test setup

Participants are provided with scenario 1 and asked to put themselves into the footsteps of Lisa. In alternating order per participant, they click through the three prototypes, after which some general open questions on their overall experience of the prototype are asked. Next, they are provided with comparison assignments, concluded with an open interview to ask more in-depth questions.

Fig 40 *General test setup sprint 1*

> There is also not a linear journey of what is the best travel plan, because I think you always determine that yourself
>
> *- P1, sprint 1*

7.1.3 Main results

Maan was the first choice for 5 out of 6 participants, as they felt they were in control of how to create their travel plan. Vis was rated second, and Roos was rated last, see Figure 42. Reasons for this preference was mainly as it provides a desired level of control in choosing the different parts of the trip. The one participant that did not rate Maan first, encountered some errors in clicking through this specific prototype. Figure 41 illustrates a sense of the feedback per prototype.

Figure 42 shows an overview of how participants mapped the prototypes on a comparison grid. Given the design criteria, the quadrant 'feeling supported' and 'providing surprising travel suggestions' was the main goal. In this quadrant mainly Vis and Roos were mapped.

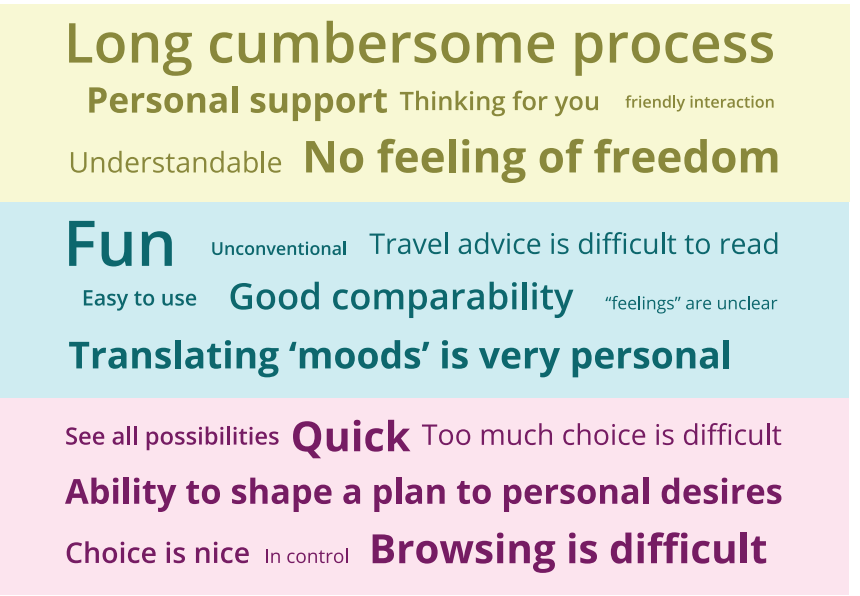


Fig 41 *Wordweb with feedback per prototype*

I feel on my own, because I can determine what my journey looks like myself

- P1, sprint 1

7.1.4 Conclusion

Being in control in shaping a travel plan according to one's own preference, is very important for participants. Travellers express they know themselves what they want and need for a trip. A planner should provide freedom of choice, which then allows a traveller to draw up a plan that fulfills personal needs. Although when travelling from and to unknown destinations as well as to persuade travellers into new travel behaviour, it is important to provide insight what possible travel modalities are and what added value these modes brings.

The "pick your travel mood" functionality is difficult, as the way this travel mood is expressed in a travel plan is very person dependent. Whereas one participant thinks travelling by car on the highway to another city is not comfortable at all, other participants feel this is the most comfortable way of travelling. Besides, participants express the need to use a manual to understand how these 'moods' work, before being able to pick a mood. On top of that, transparency in how these mood-choice influences suggestions of travel plans, is important for credibility and trustworthiness of the system.

Finally, reading icons appears to be not easy or clear for everyone.

To fulfill the formulated design goal, but also keep an eye on how individual behaviour could be persuaded into positive behaviour to overcome earlier discussed societal issues, the following design criteria and strategy are formulated.

Fig 42 *ranking prototypes on participants' personal preferences*

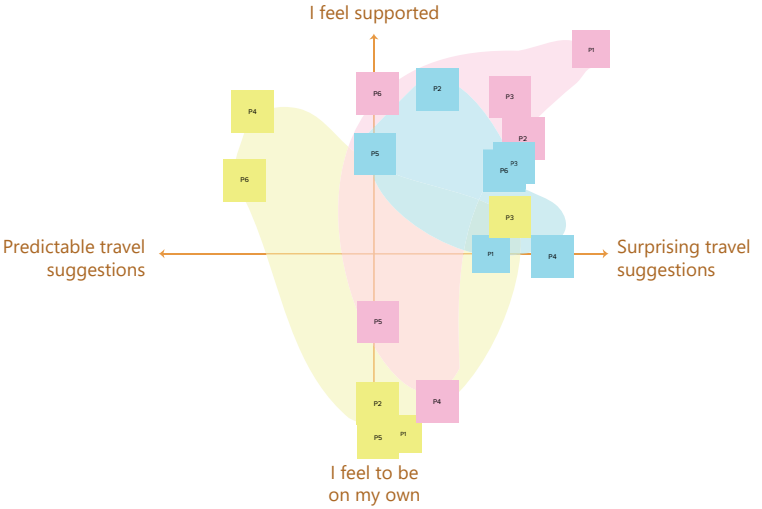


Fig 43 *mapping prototypes on comparison grid with support & suggestive axis*

7.2 Design criteria and strategy

To support travellers in making a door-to-door travel plan,
the process should facilitate

Freedom of control and choice

By providing choice for all legs of the trip to allow for composing a plan that fits their needs

By balancing the level of own-choice and support by the system to prevent the process to become unmanageable or too complicated

Quick/speed

Add Vis' feelings 'as an option to save preferences' to generate speed for future planning

As this interpretation of 'feelings' is very personal, travellers should be able to set and label it themselves

Easy

Interactions should be similar to existing services to fit travellers mental modal and reduce cognitive load

Interactions should be inline with UX conventions

Rethink current icons, and use supportive labels

the app should facilitate creating a plan that is

In line with their trip dependent needs

To support the traveller in making decisions on how to travel from door to door by reducing cognitive load

Personal

Allowing to create a travel plan that fit travellers personally

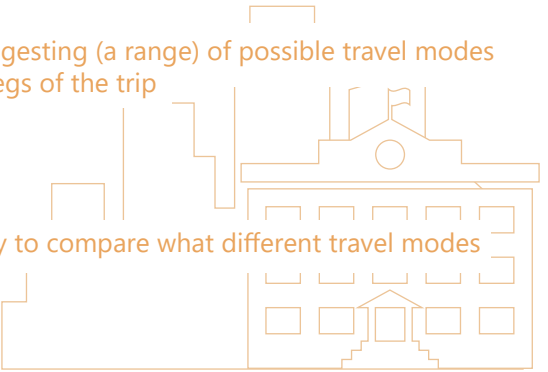
To stimulate travellers for new travel habits, the app
should provide and allow for

Inspiration

Stimulate by suggesting (a range) of possible travel modes on all different legs of the trip

Comparison

Ensure the ability to compare what different travel modes offer to the total



| 7.2.1 Testable targets

Provide self-control and choice

While going through the door-to-door travel plan process, travellers should experience an acceptable level of control and choice in shaping their travel plan. These targets will be qualitatively and quantitatively tested within open interview questions and a five-point Likert scale questionnaire. In general, spoken feedback should be positive, and Likert scale results should be **4 or higher**.

Quick/speed

The creation of a door-to-door travel plan should be experienced as sufficiently quick. As usability issues could slow down travellers to use the system, these targets are tested by different quantitative and qualitative measures: open interview questions, a five-point Likert scale questionnaire and SUS scale. As negative experiences regarding the speed of a process could form a threshold for service adoption, the SUS score should be **above 68** and the Likert scale results should be **4 or higher**. Besides, observed click behaviour and spoken feedback should indicate an overall positive experience regarding the speed of the process.

Easy

The creation of a door-to-door travel plan should be experienced as a sufficiently easy process. These targets are tested by different quantitative and qualitative measures: within open interview questions and SUS scale. As negative experience regarding the ease of use could form a threshold for service adoption, the SUS score should be **above 68**. Besides, observed click behaviour and spoken feedback should indicate a positive experience regarding the ease of use of the process.

Inspiring

During the creation of a door-to-door travel plan travellers should experience the provided travel mode options are inspiring or 'new' suggestions one did not consider yet. This target will be qualitatively and quantitatively tested within an open interview question and a five-point Likert scale questionnaire. In general, spoken feedback about the provided travel mode suggestions should give a sign of being 'inspiring' or 'new', and Likert scale should be **3 or higher**.

Comparable

During the creation of a door-to-door travel plan travellers should experience the application allows to compare different travel plans to an acceptable level and in a way it supports their decision making. This target will be qualitatively and quantitatively tested within an open interview question and a five-point Likert scale questionnaire. In general, spoken feedback about the comparability functionalty should be positive, and Likert scale results should be **3 or higher**.

Fulfilling trip dependent needs

The travel planning process should facilitate the creation of a travel plan that fulfils trip-dependent needs to an acceptable level. This target will be qualitatively and quantitatively tested within an open interview question and a five-point Likert scale questionnaire. In general, spoken feedback about the comparability functionality should be positive, and Likert scale results should be **3 or higher**.

Personal

The travel planning process should facilitate the creation of a travel plan that feels like an acceptable personalised. This target will be qualitatively and quantitatively tested within an open interview question and a 5point Likert scale questionnaire. In general, spoken feedback about the personalisation aspect should be positive, and Likert scale results should be **3 or higher**.

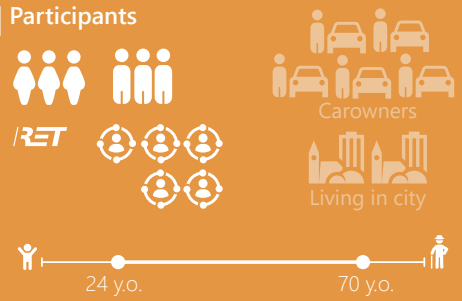
Sprint goal

Manifest the design strategy into one design concept and discover to what extent and what functionalities ensure travellers experience the formulated design criteria.

Main activities

Ideate one design concept and use flow. Prioritise functionalities and translate it into a mid-fidelity click-prototype. Test it regarding the design criteria and on usability by a combination of quantitative attitudinal and qualitative behavioural research.

Participants



Sprint duration

two weeks

More details

A full and detailed overview of this sprint, it's prototype, test setup, results and conclusions can be found in Appendix 13.6

7.3 / Sprint 2

7.3.1 Concept and prototype

Ideation is done by a simple market analysis about different service applications, focussed on plan functionalities as well as personalisation.

Concept

The concept is focussed around providing a traveller with two ways to create a travel plan, see Figure 45 and 46. Initially, the only method to plan a trip is by composing one from scratch. This is aimed to provide control and choice of travel-mode per leg of the trip. After composing the trip, an overview is provided with the option to save the plan or compare the plan with another plan.

After saving the plan, travellers are provided with the option to save characteristics of the trip in a 'Reisbehoefte groep' (*travel-need group*). This feature allows to cluster specific travel needs in a group. The idea is that when planning a new trip, the traveller could use this group to get complete travel plan suggestions in line with these travel needs. This functionality aims to speed up the planning process and inspire travellers.

As not all features of this use flow are essential to communicate the concept's main essence, a 'black box' is used for the creation of a profile and 'add details to profile'.

Main functionalities

- A planner with choice per leg of trip by means of carrousel-interaction
- Overview of composed travel plan
- Saving travel plan for future reference, only possible when creating a profile
- Creation of 'Reisbehoefte groep'
- Comparability functionality to allow comparing 2 or 3 travel plans

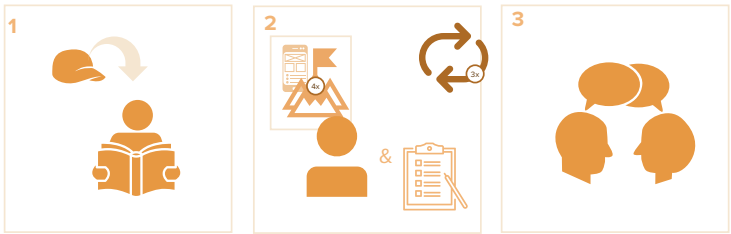


Fig 44 *General test setup sprint 2*

7.3.2 General test setup

Participants are provided with scenario 1 both within the email invitation and at the start of the test, and are asked to put themselves into the footsteps of Lisa. Then they are invited to complete four missions in Maze by means of the click-prototype. After this, two closed questionnaires are filled in; a Likert scale regarding design criteria and the SUS. At the end, a concluding open unstructured interview is held.

7.3.3 Main results

An overview of quantitative results is shown in Figure 47. Some qualitative results will be discussed below.

3 out of 6 were in disagreement with the statement “I think I would like to use this app often”. Reasons were the app provides no added value oppose to current applications

‘Comfort’ is for example different per modality how it manifests itself

- P4, sprint 2

participants use for planning a trip. Besides, most participants travel usually by car, for which they express no application is used to plan a trip, or at least not during the decision-making process of a trip.

The ‘travel need groups’ functionality was not directly understood. Although after some discussion, a few participants expected this functionality to work as intended. Eventhough not all participants were positive, some express this functionality would be interesting when planning non-incidental trips. Reasons for this functionality to be unclear was due to the name. Besides, it was unclear how the different parameters would be reflected in the a travel plan suggestion. On top of that, doubts are expressed regarding the current

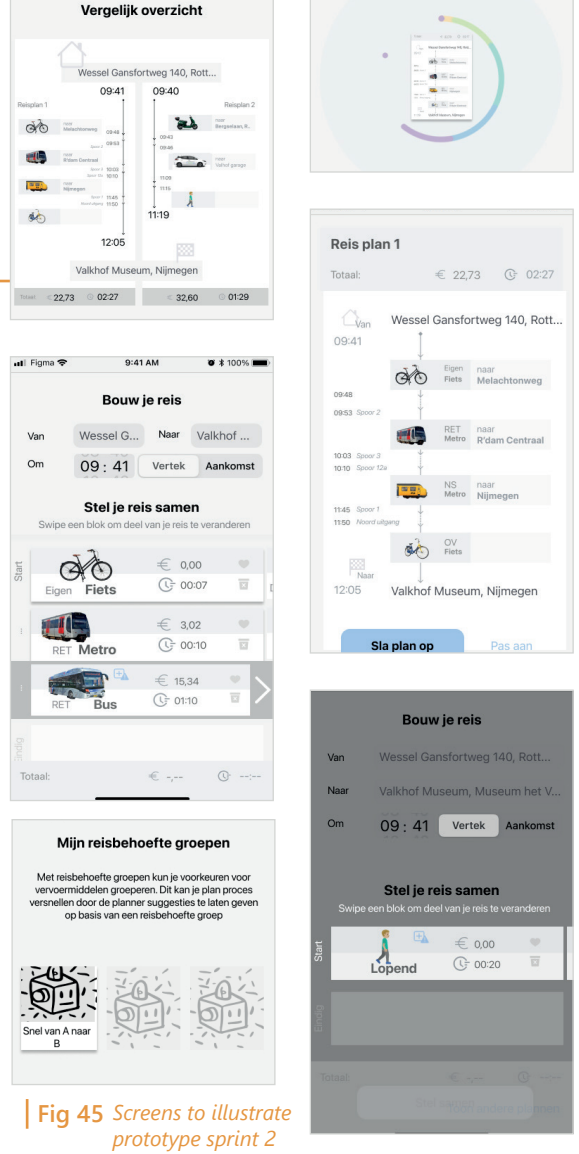


Fig 45 *Screens to illustrate prototype sprint 2*

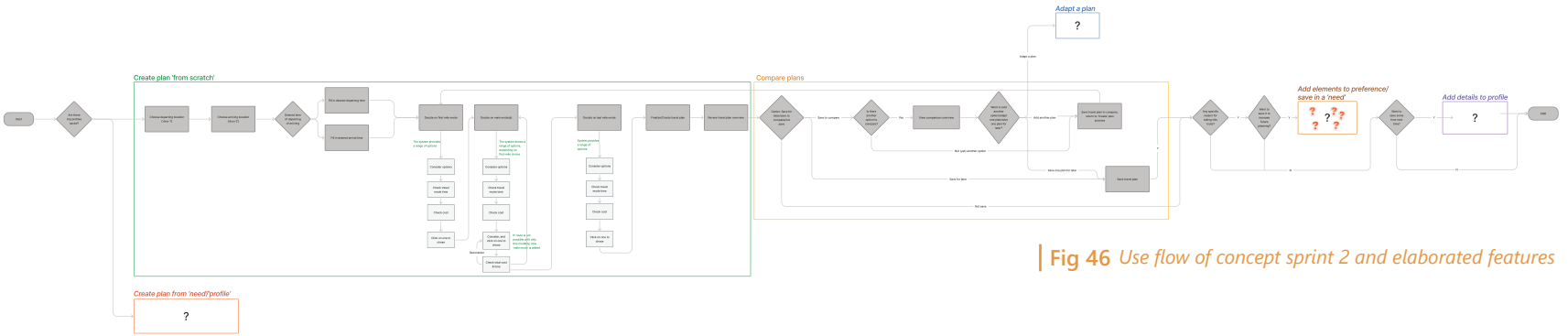


Fig 46 *Use flow of concept sprint 2 and elaborated features*

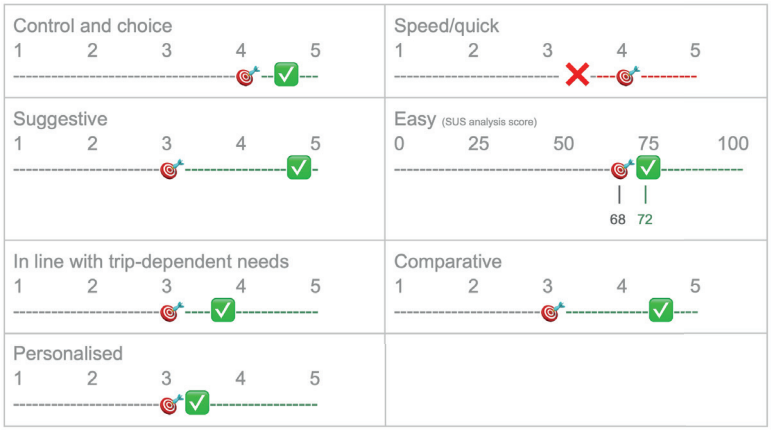


Fig 47 *overview of testable targets and quantitative results sprint 2*

First time planning

Second time planning

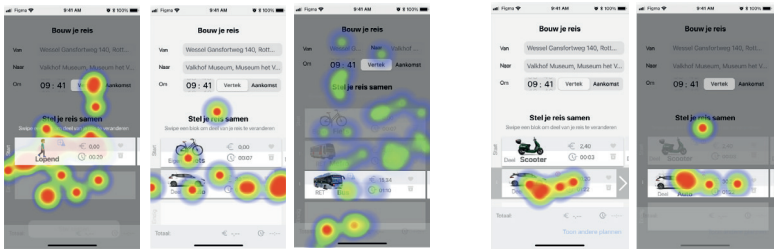


Fig 48 *heatmaps carrousel interaction prototype test sprint 2*

> In the beginning the swiping was a bit unclear, afterwards is was really easy
>
> *- P6, sprint 2*

used parameters of a travel-need group, as the provided ones are very personal and differ highly per transport mode.

Initially the carrousel swipe interaction in the planner has a high amount of misclicks, although the second time participants planned a trip showed a quick learning curve, see Figure 48.

7.3.4 Conclusion

In general, almost all testable targets are met with respect to their quantitative results . Qualitative results in the form of spoken feedback and observed behaviour give, however, more insights in points for improvement.

From this test could be concluded that we are heading in the right direction. It shows potential as the current prototype already supports travellers in their decision-making process as information search and evaluation of alternatives is stimulated by the comparer functionality (overview) as well as the planner functionality (suggestions carousel interaction per leg of trip).

Although to support travellers even better in these decision making steps, and to provide an added value compared to existing trip planning applications for both ‘persistent PT travellers’ as ‘stubborn car drivers’, the current planner and comparer functionality have to be elaborated further. Besides, to support travellers with creating a travel plan that is more responsive to and in line with their trip-dependent needs, and at the same time speed up the planning process, the ‘Travel need groups’ functionality has to be improved in terms of usability and learnability of how to use the functionality in the planning process (Wilson, 2019).

Improvement strategy

The main focus is on supporting (and stimulate to change) travellers' mode choice in their search for information and evaluation of alternatives, by improving the comparer and planner functionality. Besides, the overall app flow will be improved by providing a desired level of trialability and improving the 'travel need groups' functionality to make it better to understand and easier to use.

Improvements on the overall concept:

Improve overall app flow

- Design with a desired level of (initial) trialability
  - *allow to use the basics of the app without the a profile/account*
  - *communicate what added value the creation of a profile brings*
- Provide options to speed up the plan process by an easy-to-use and easy-to-understand 'Travel need groups' functionality
  - *rename the functionality*
  - *introduce the functionality by a demo/tutorial/onboarding*
  - *create a low threshold by providing 'predefined' travel need group*

Stimulate change by inspiring travellers

- Communicate 'smart' suggestions or tips that a specific travel mode could bring. These should be in line with their trip-dependent needs as well as personal capabilities

Provide added value for 'car drivers'

- By providing relevant information for car travelling, like parking locations and transparency in overall cost

Improve planner and comparer functionality:

Combine functionalities

- Investigate how these two functionalities could be combined in a way travellers can clearly and transparently see the data per leg of the trip as well as an overview of the 'totals'.

Planner

- Only show mode options that are in line with their personal possibilities (e.g. drivers license)
- Rethink the interface and interaction design of the carrousel interaction
- Communicate clearer how the sub steps of the trip is build up, especially regarding the locations that is travelled from and to

Comparer

- Better suitable for mobile app devices, both on interface as interaction design
- Allow for comparability between travel modes on all legs of the trip as well as the entire trip

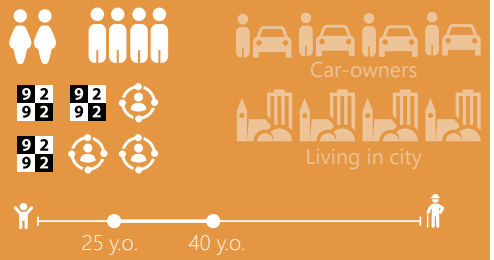
Sprint goal

Iterate on the design by processing improvement points formulated in sprint 2, test and formulate improvements for the final design.

Main activities

Iterate the concept on conceptual, interaction and usability level. Ideate use flows, prioritise main and essential functionalities and create a high-fidelity prototype. Finally, test the design on the design criteria as well as on usability by a combination of qualitative attitudinal and behavioural research.

Participants



Sprint duration

two weeks

More details

A full and detailed overview of this sprint, it's prototype, test setup, results and conclusions can be found in Appendix 13.7

7.4 / Sprint 3

7.4.1 Concept and prototype

Ideation is done by an informal brainstorm with the Personal Seamless Mobility lab and by a sharing session and brainstorm with designer of 9292.

Concept

In line with the previous concept in sprint 2, the concept allows travellers to create a travel plan in two ways; by means of the 'Configurator' or the 'Versneller', see Figure 49. The first method allows to create a travel plan from scratch and provides the traveller with full control and choice per leg of the trip. While composing a travel plan by means of the Configurator, the amount of information per step of the trip alternates depending on the main action, as illustrated in Figure 50. This is aimed to reduce cognitive load by lessening excess content (Guerra, 2020).

The second method aims to support the traveller in creating a personalised travel plan and to speed up the planning process. By first picking a "Reismodus" that is in line with one's trip-dependent needs, the system provides subsequently a few complete travel plan suggestions. Such a "Reismodus" consist out of a set of different settings and functions like a filter or criteria the suggested travel plans have to meet. Initially, a few of these "Reismodi" are provided, to lower the threshold for users to start using this functionality as well as to support learnability on how this functionality works.

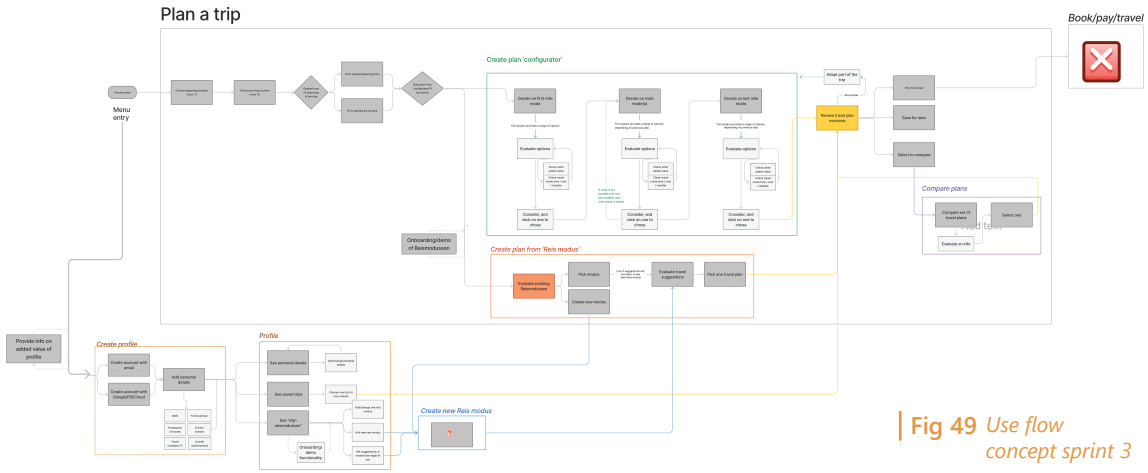


Fig 49 *Use flow concept sprint 3*

Eventually, both plan methods provide an overview of the travel plan, which offers options to save the plan for future reference and/or comparison, or to buy tickets, make reservations or book travel modes. The latter is not part of the scope of this project.

Different onboarding features are used to familiarize users with the application. The goal was to either promote a functionality (Versneller and profile creation) or to provide instructions on a functionality (Reismodus).

Main functionalities

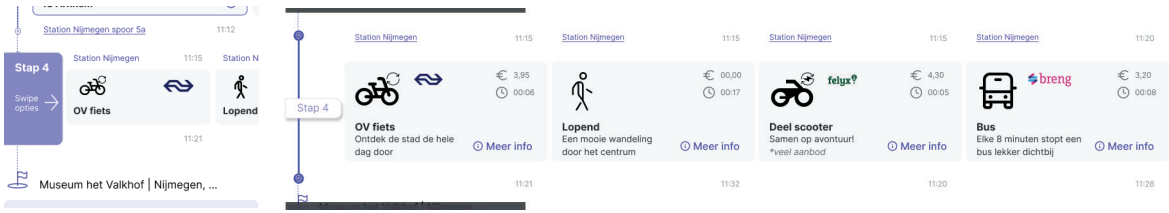
- Configurator
- Versneller that provides to plan by means of a Reismodus.
- Creation or adaption of a Reismodus to set it to a one's personal needs.
- Compare feature to allow comparing different travel plans
- (Create a) profile with personal details, locations, possessed travel modalities and subscriptions, and Reismodi

7.4.2 General test setup

In general the test setup was similar to Sprint 2, see chapter 7.3.3. This test consist of four missions: 1. Put together a travel plan that meets the desired characteristics of the trip (and save it); 2. Compare two travel plans; 3. Quickly create a travel plan (and save it); 4. Speed up your planning process by saving a Reismodus.

7.4.3 Main results

An overview of quantitative results is shown in Figure 51. Some qualitative results will be discussed below. Participants were in general positive regarding the application and it's functionalities. They felt to be more in control than is the case with conventional planners as well as being able to compare alternatives better. The app is experienced as being complete; providing a clear idea of all travel options that are possible. It reduces the threshold of the planning and decision-making process as the app supports one's thinking process.



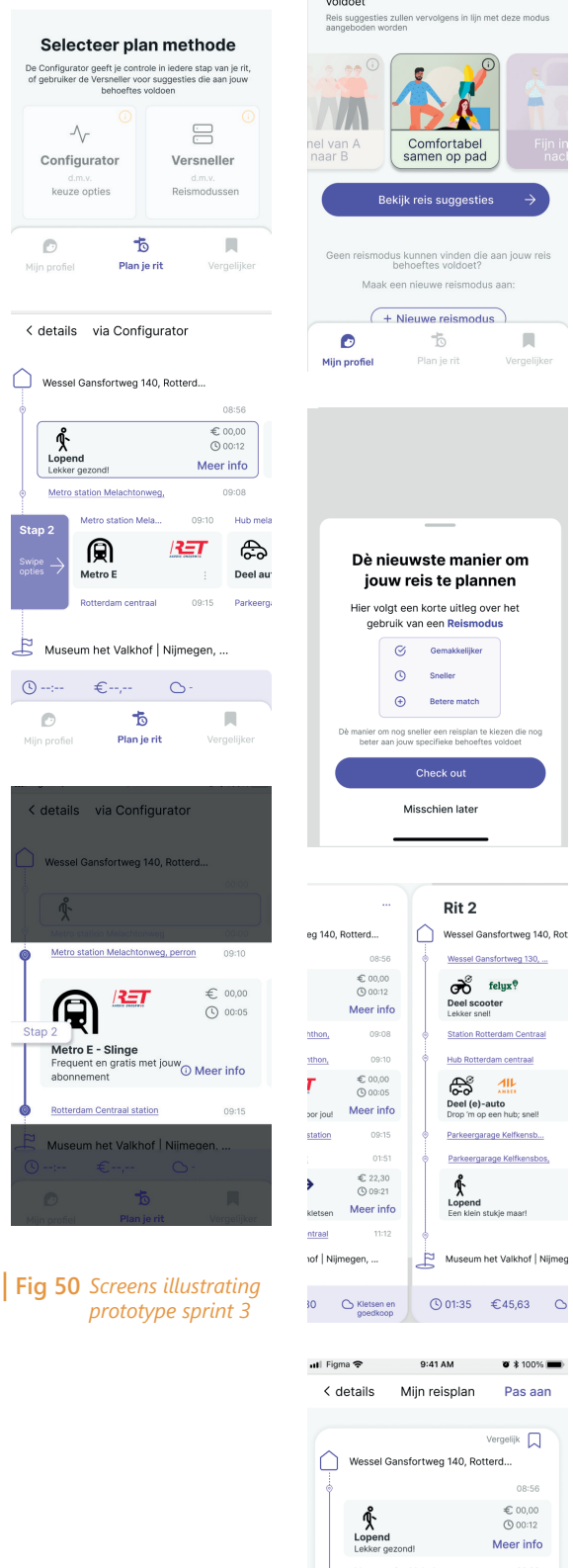


Fig 50 *Screens illustrating prototype sprint 3*

Fig 51 *overview of testable targets and quantitative results sprint 3*

Although participants also expressed the many different functionalities make the initial learning curve as a notice user difficult. This is also reflected as not all participants understood the different functionalities from the start. Especially the difference in "Configurator" and "Versneller" was initially unclear, raising questions and uncertainty in what to do. Besides, the interaction on comparing different plans and creating a new Reismodus was not intuitive for all. Not all participants achieved to fulfil these missions, and participants were searching and expressing doubts during these two missions. Although once understood, especially the compare and Reismodus functionality were valued highly. Potential was seen in terms of support in their decision-making process and improving the speed of creating a travel plan.

During the test, some errors were encountered due to the Maze testing tool and click prototype interactions. This caused some participants to not fully able to explore all functionalities of the prototype, and might also induce usability issues.

7.4.4 Conclusion

Whereas most of the testable targets are met with respect to their quantitative results, the test shows that the design should be improved on ease of use and speed.

In general the overall use flow and main functionalities are understood as intended and positively experience. However the 'Reismodus' functionality is not understood by every participant. Although it shows high potential as, when understood, participants expressed this functionality as an added value compared to existing planners.

Apart from this, the ability to compare different travel plans was highly valued as well, only should be improved by clearly providing an overview of the essential elements in one screen view.

> In my opinion you get a very complete and clear picture of what your options are in a 'lazy' way. Currently, you must think yourself what your options are, how they work and what your choice will be. This app makes that process much more accessible!
>
> *- P4, sprint 2*

Improvement strategy

The main focus is on enhancing the degree of learnability of the app, it's added value, and improving the discoverability of the main functionality that allows for speeding up the planning process ('Reismodus')

Improve use flow and functionalities

Improve learnability

- Improve overall app learnability by providing general information about the application and its main functionalities: "show, don't tell"

  For example, by means of info screens in the app store, an introduction demo or onboarding after installing, the main functionalities and value of the app should be communicated. This supports users to understand the added value the app could provide them, but this could also provide some initial guidelines on the use of the app. This could improve usability of the caroussel swipe interation, provide support in chosing a planning method ('Configurator' 'Versneller', promote the use of a Reismodus

Rethink the names of plan methods

- Current names "Configurator" and "Versneller" should be renamed and corresponding labels and icons should be supportive

Improve navigation to different functionalities

- Especially the use flow to compare two or more travel plans should be improved on usability
- Add new Reismodus

Improve comparing overview

- By allowing to compare the main elements/totals of the different trips in one clear overview for which no back and forth scrolling or swiping is necessarily
- Allowing to find more information and to adapt one plan

Improve prototype interactions

Prototype fidelity

- By improving the prototype itself, for example, it should be ensured that there is always a possibility to return to the previous screen.

7.5
/ Design functionalities

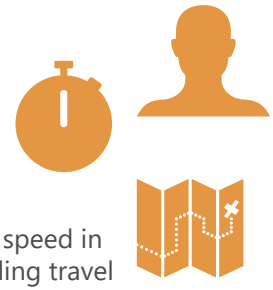
The iterative process carried out by means of multiple sprints generated insights in a set of required functionalities for the final design to fulfill the design goal. These functionalities are elaborated in this chapter.

Freedom of control and choice

- Configuration all legs of the trip to provide control & choice, and support travellers information search

Easy

- (Some) elements similar to existing planners by using UX conventions and patterns
- Enhance learnability & discoverability to support travellers in the use of this application and diverse functionalities



Speed, Personally relevant & in line with trip dependent needs

- Filter travel suggestions to provide speed in finding a relevant & trip-need fulfilling travel plan
- Create or adapt a predefined filter to own travel needs to provide option for adapting filter to specific personal needs
- Personal travel modes and subscriptions should be showed in travel mode suggestions and used to provide personally relevant tips

Inspiration

- Make mode suggestions inspiring and tangible allows to see what added value ‘different’ ways of travelling could offer and to create a window of opportunity for stimulating travel behaviour change
- Browsing through variety of options allows for exploring possibilities and finding ‘new’ opportunities

Comparison

- Possibility to compare complete plans as well as legs of the trip to support in evaluation of alternatives
- Clear travel plan overview to support the traveller in evaluation of alternatives

8 Final design

Main chapter insights

The final design is a journey planner sparking travellers with endless personalised travel possibilities. In the form of a white-label app, this design is envisioned being part of a MaaS application that supports travellers in their search for information and evaluation of possible travel modes and routes.

The app provides travellers with two methods to create a door-to-door travel plan. The Reismodus method provides a few complete travel plans filtered by a personally chosen travel mode. On the other hand, travellers are provided with full control by the ability to compose the entire travel plan from scratch. On top of that, creating a profile and adding personal transport modes, subscriptions and/or discount cards, allows for evaluating the values that are truly apply to oneself.

Get inspired, recognize opportunities
and make it fit for you

- Sara Schippers

8.1
/ Main message

"Get inspired, recognize opportunities and make it fit for you"

What is the best way to get into an unknown city? Where can I park the cheapest and easiest? How can I effortlessly transport a lot of things, go out with my children in a fun way or travel home comfortably and with a safe feeling in the evening? Finding the best travel plan for your travel goal can be a hassle. The world of mobility is changing and improving. Mobility as a Service (MaaS) combines all forms of mobility and other aspects of your journey in one mobile application. It can enhance your travel experience and could also make our mobility system more future proof.

MaaS opens possibilities to move ourselves better, more easily and well suited from door to door. Make quickly and effortless a choice in how you want to travel. Start by seeing where the added experiential value lies for you, start by discovering new and interesting travel options.

See, consider, compare, choose and travel

In dutch:

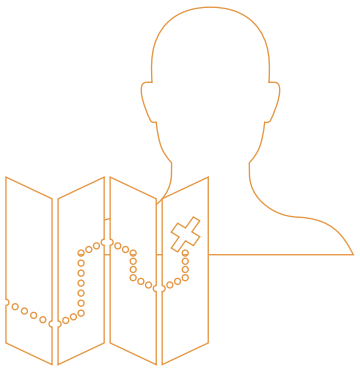
"Laat je inspireren, ontdek de mogelijkheden en maak het passen voor jou"

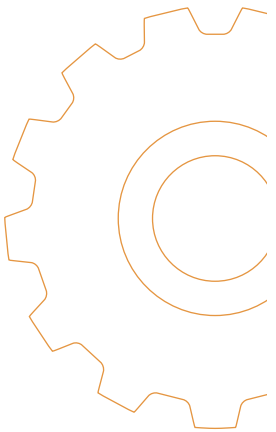
Waar kan ik het goedkoopste en gemakkelijkste parkeren? Hoe kan ik het beste een onbekende stad in komen? Op welke manier kan ik moeiteloos veel spullen vervoeren, met mijn kinderen op een leuke manier op pad of 's avonds comfortabel en met een veilig gevoel weer thuiskomen? Het vinden van jouw beste match voor een reisplan kan gedoe zijn. De wereld van mobiliteit verandert en verbetert. Mobility as a Service (MaaS) voegt alle vormen van mobiliteit en andere aspecten van jouw reis samen in één mobiele applicatie. Het kan jouw reiservaring nog beter maken én creëert daarnaast mogelijkheden maatschappelijke problemen op te lossen.

Het opent mogelijkheden om ons beter en gemakkelijker van deur tot deur te verplaatsen. Maak nu sneller en eenvoudige een keuze in hoe jij wilt reizen. Start met inzien waar de toegevoegde belevingswaarde voor jou ligt, start met inzien van nieuwe en interessante reismogelijkheden.

Zie in, overweeg, vergelijk, kies en reis!

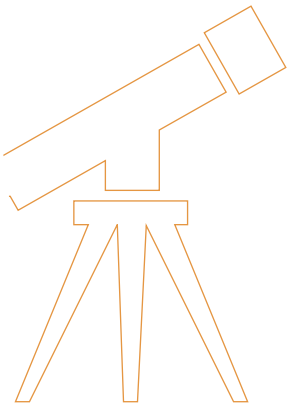
8.2
/ Design description





The final design is a planner functionality, envisioned as a component of a MaaS app. It aims to support travellers in creating a door-to-door travel plan that fulfils their trip-dependent needs. By enhancing the process of information search and evaluation of travel alternatives and by providing inspirational suggestions, travellers are offered support in their decision-making process.

The app offers the ability to **quickly** and **easily** choose a travel plan that matches a specific travel goal. But it also offers the possibility to compose an entire travel plan from scratch, providing travellers with a high level of **control** and freedom of **choice**. Besides, the design is envisioned to support persuading travellers into new travel habits. This is on one hand done by **inspiring** travellers by providing the ability to browse through different options per leg of the trip, as well as options of complete travel plans. These travel options include a wide range of possible travel modalities, by which the added experiential value a travel option could provide is highlighted. On the other hand, persuading travellers into new travel habits is promoted by offering a hassle-free possibility to **compare** alternatives. This all allows for creating a travel plan that fit one's **personal** capabilities and is in line with one's **trip-dependent needs**.



The design consists of different functionalities that serve a role in fulfilling the above highlighted design elements. These functionalities will globally be discussed below and elaborated in more detail in the next chapter.

Main functionalities
The planner allows travellers to plan a trip by two different methods; by means of a Reismodus or Stel samen configuration.

By presenting travel suggestions filtered on a specific set of travel needs, the **Reismodus** plan method offers to quickly and hassle-free find a travel plan that fits one's needs. In line with the Hick-Hyman Law, it only presents a few complete travel plan suggestions to provide options, but not overwhelm travellers with choice (Guerra, 2020).

By shaping a travel plan completely from scratch with the "**Stel Samen**" configuration method, travellers are provided with control and choice on travel mode and route for all legs of the trip. This plan method offers the freedom to compose a travel plan completely to one's desires.

Once a plan is created, independent of the used plan method, a **travel plan overview** is provided. This functionality allows to evaluate the chosen travel plan and, if desired, make adaptations. Besides, this view offers the option to save the plan for future reference or mark the plan for comparison, share with others and provide to navigate to creating a new travel plan.

After marking different travel plans for comparison, the **comparer** functionality allows travellers to clearly compare travel plans on different elements. It presents the total travel time, cost and highlights experiential value of each plan in one clear overview. It supports decision-making by enhancing the evaluation process and potentially also stimulates travellers into considering new travel methods and behaviours.

The different functionalities this planner provides, make the app interesting although unconventional as a planner. To support usability and service adoption, the added value of the app and its functionalities have to be learned and discovered. The design has different elements to support learnability and discoverability. For example, in the app store and after installation an **demo of the application** is offered, to convey

the app's the main message. Besides, during the use of the app **short demos** are used to instruct or promote the use of a feature. In addition, progressive disclosure is applied to support learnability for novice users. The most essential and useful features are initially in focus and confusingly advanced features are first hidden (Nielsen, 2006). For instance, at the beginning a few predefined Reismodi are provided to lower the threshold to start using this functionality and to enhance learnability on how this functionality works. **Adapting a predefined Reismodus** or creating one from scratch is possible to enhance personalisation, although as a secondary action.

For users to adopt the use of this MaaS app, it is important to allow travellers to experience the service (on a limited basis) to see its value (Rogers et al., 1971). Therefore, it is important to provide a desired level of trialability. Essential in this is to offer the possibility to using the app's main functionalities on a basic level without the need nor hassle of creating an account. Although, to use the app to its full extent, the use of a **profile** is essential for saving data and settings. For instance, to compose a personal Reismodus, to save personal details, add personal travel modes and other preferences, a profile is needed.

8.3
/ Design details

8.3.1 Use flows

The way the previously elaborated functionalities are incorporated is illustrated in a use flow, see Figure 52. From the main screen menu entries to plan a trip, compare trips and profile are provided by means of a bottom navigation bar.

This design is envisioned to be part of a MaaS app, therefor links to other MaaS functionalities, like ticketing and booking, are provided, but not elaborated as is visualised in the use flow as well.

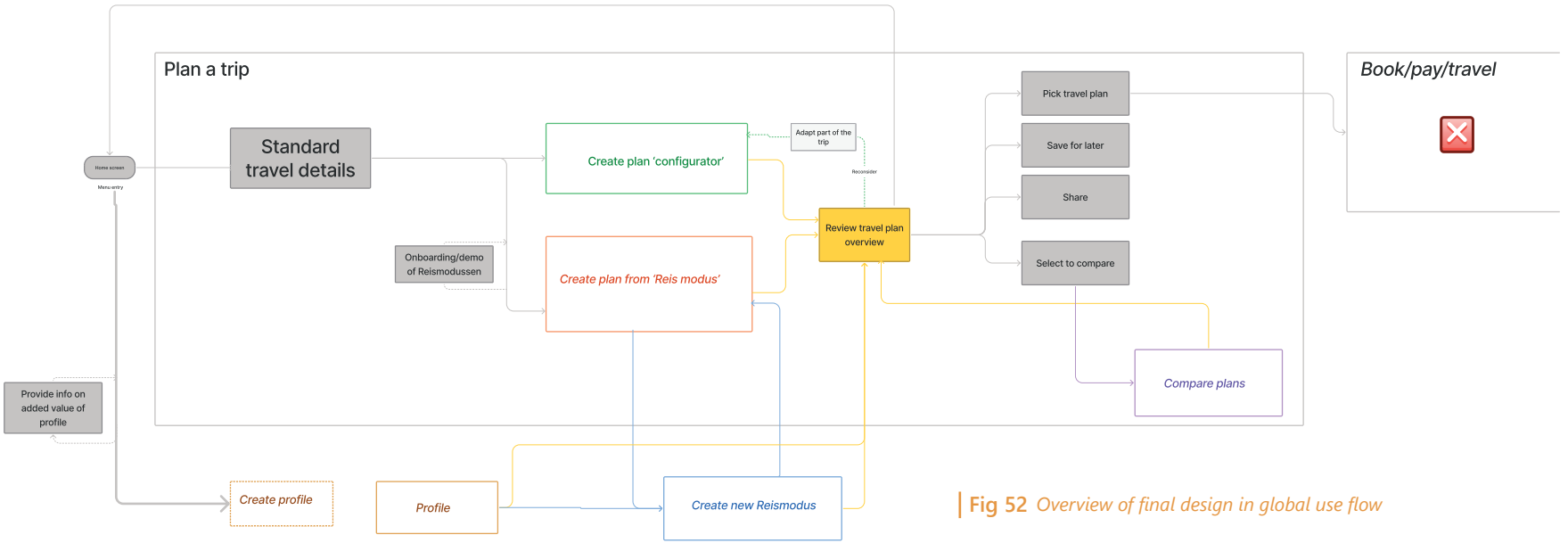


Fig 52 *Overview of final design in global use flow*

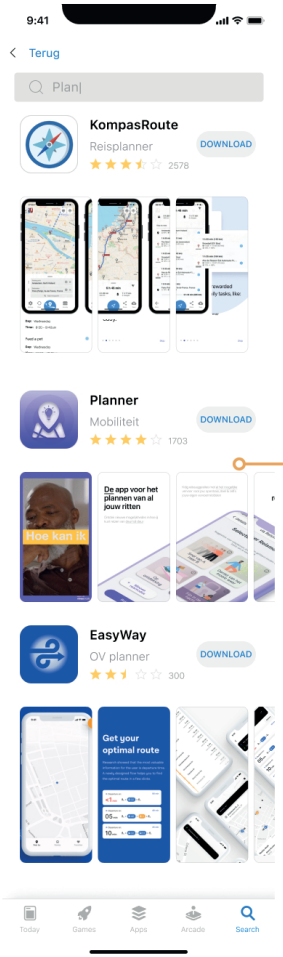
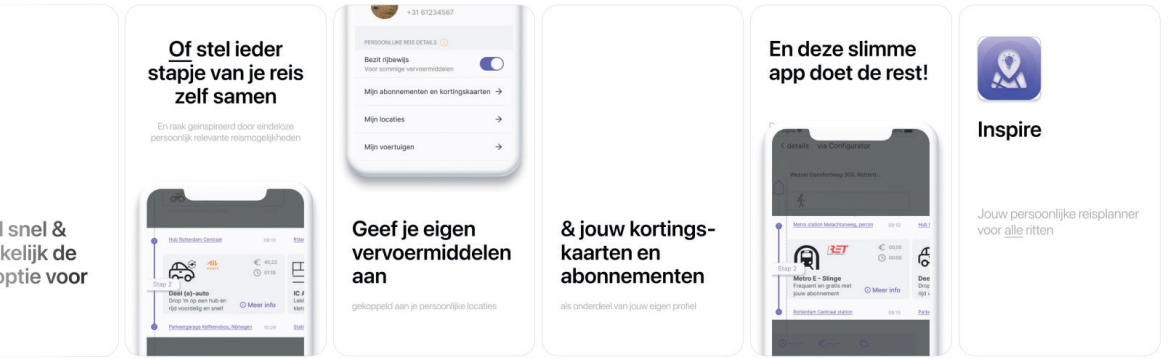


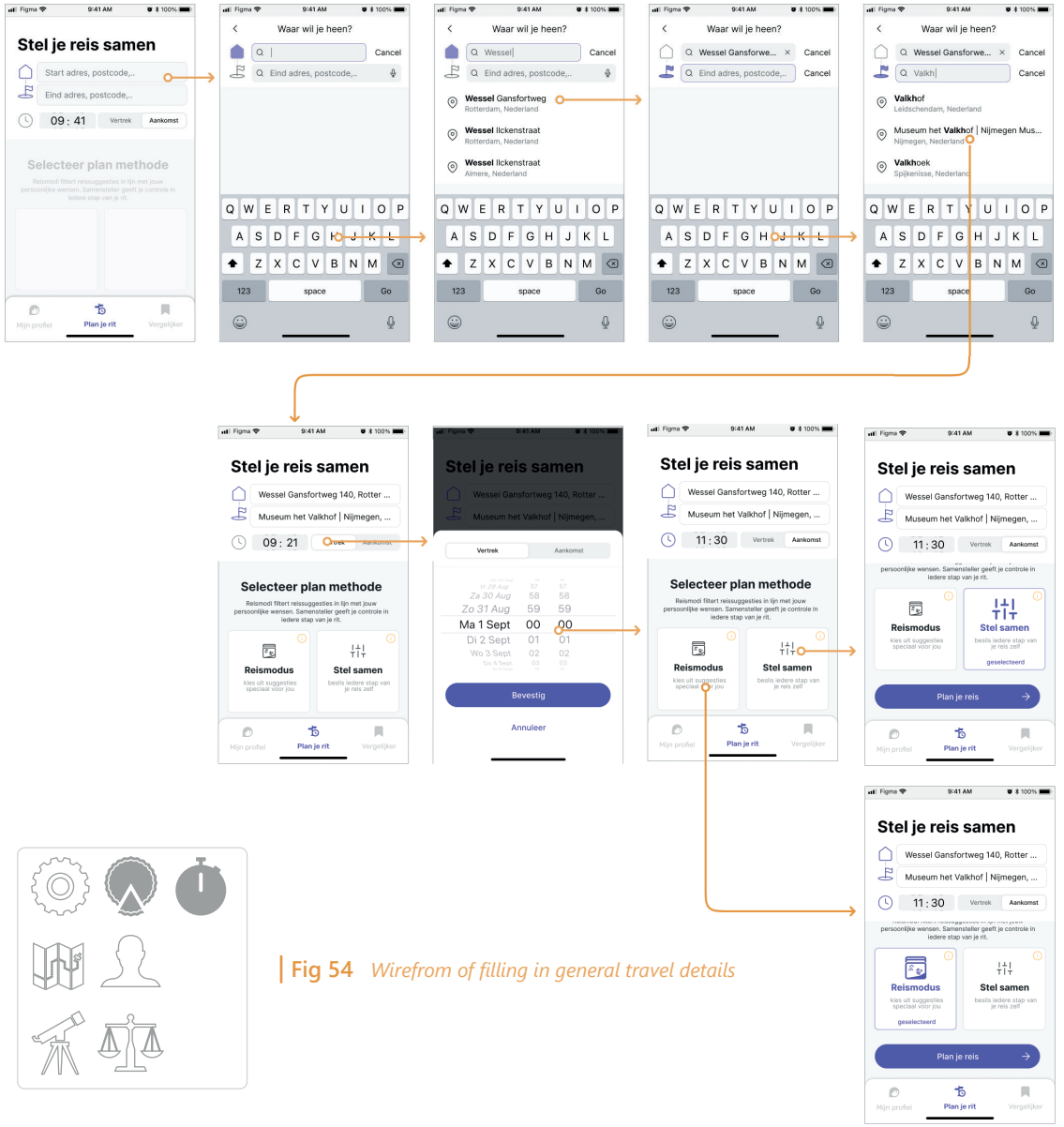
Fig 53 *App in app store*



| 8.3.2 Functionalities

App demo in app store

To grasp attention and support discoverability of the application, the app's main message is conveyed in text, visuals and a quick promo demo video in the app store, see Figure 53. The promo demo video starts by raising some main questions regarding challenges travellers might encounter while planning a trip. Next, the app's functionalities are presented as a way to overcome these challenges. Apart from this video, the main functionalities are highlighted by visuals and supported by short information texts.



| Fig 54 *Wirefrom of filling in general travel details*

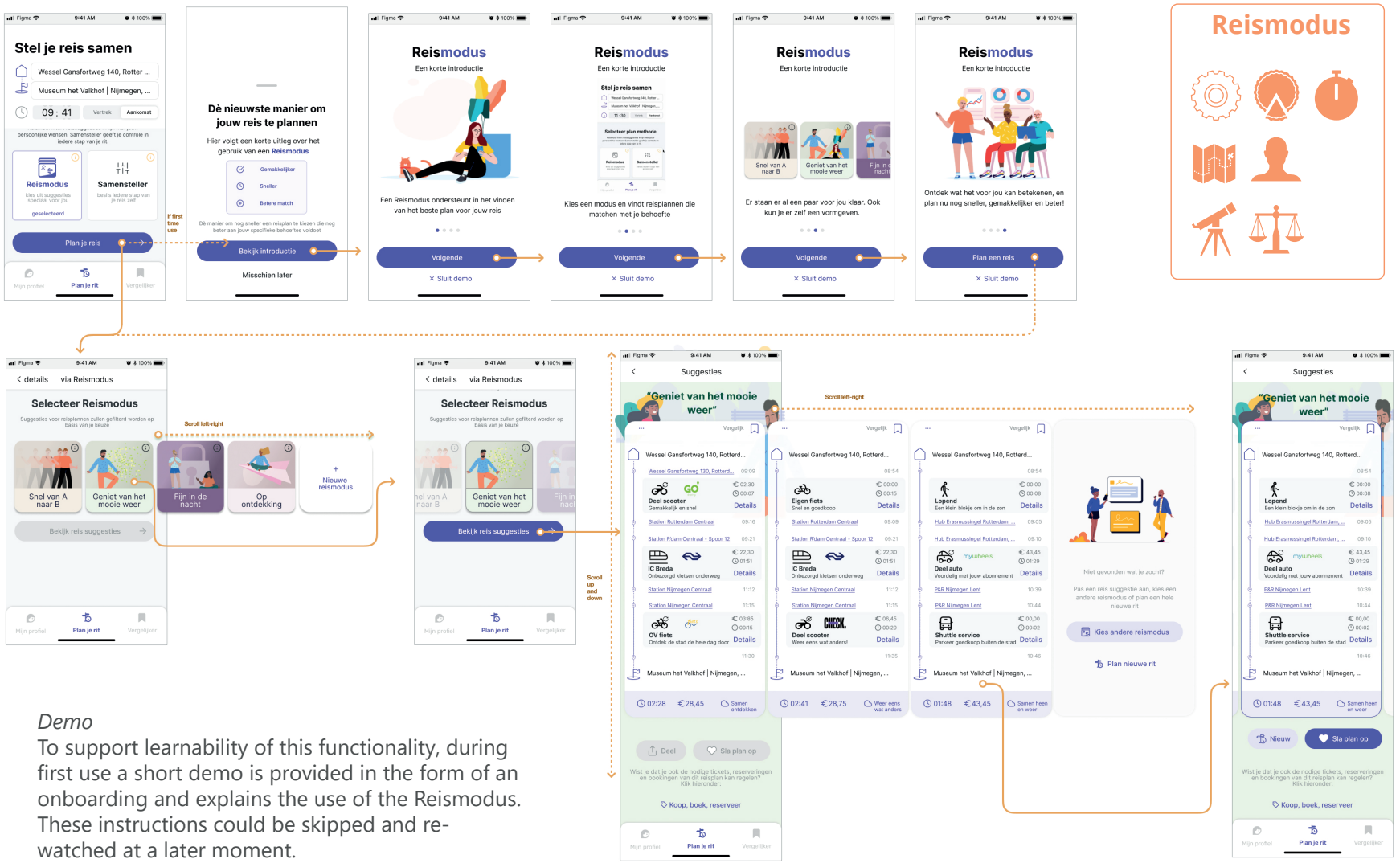
Plan a trip - general details

The wireflow visualised in Figure 54 shows that the planning process starts with filling in some standard travel details, like departure and arrival location, date and time. After this, the choice is made to plan either with the Reismodus method or the Stel samen method.

Planning by Reismodus

Visualised in Figure 54, this functionality is aimed to support travellers in their activity of making a door-to-door travel plan by facilitating speed and ease. A Reismodus functions like an advanced filter that filters complete travel suggestions based on a specific set of travel needs. For example, there might be the Reismodus “Fijn in de nacht” (translated: comfortable in the night), that provides travel plan suggestions with a high perceived safety; e.g. little transfers, no transfers at deserted locations, and prioritizes crowded public transport modalities over empty or deserted ones.
A travel plan suggestion consists of the departure and arrival location, various trip legs, total travel time and cost as well as qualitative experiential value given by the system.

To support persuading travellers to adopt new travel habits by travelling with a wide range of travel modes, travel plan suggestions also include a variety of travel that are in line, however, with the chosen travel mode. Besides, a short text (at the bottom of a trip leg) highlighting an added value of the travel mode is envisioned to support this persuasion as well.



Demo
To support learnability of this functionality, during first use a short demo is provided in the form of an onboarding and explains the use of the Reismodus. These instructions could be skipped and re-watched at a later moment.

The system provides a few predefined Reismodi to lower the threshold to start using this functionality and to enhance learnability on how this functionality works. Users with an app profile are also provided the possibility to adapt

Fig 55 *Planning by Reismodus detailed wireflow*

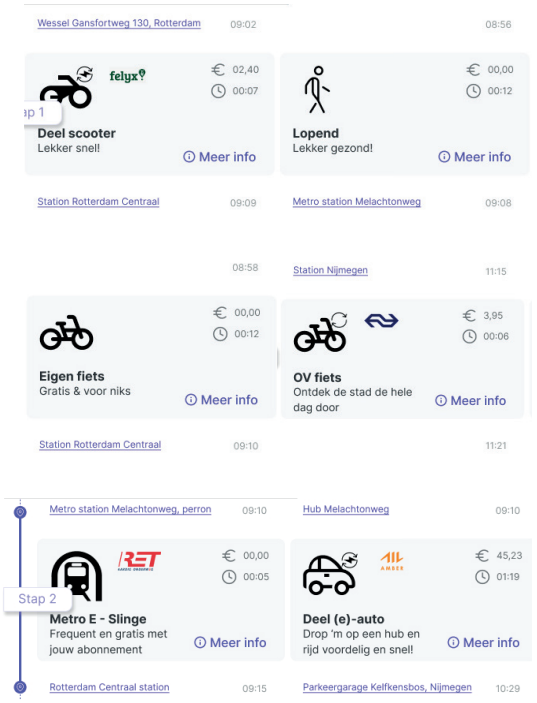


Fig 56 *Some examples of trip legs*

these predefined Reismodi to their own preference or to create one from scratch. This functionality will be discussed later on.

Potential additions to functionality
The travel plan suggestion filtered by the Reismodus could also be reflected in the route suggestion. For example, with a Reismodus regarding "Exploring a city comfortably" route suggestions could reflect this mood by presenting an easy-to-remember cycling/walking/etc route. This could for example be done by providing a route that quickly navigates to a 'speed lane' or simply by a route with little turns but following one street as much as possible. In this way there is little necessity to consult the journey planner during the trip.

Trip leg
Figure 56 shows various examples of trip legs. For both the Reismodus as the Stel samen plan method, a travel plan is composed by various trip legs. Within each trip leg the travel mode is communicated by an icon, in text and, if applicable, a logo of the service provider. Each leg also shows the departure and arrival locations and times, as well as total time and cost. By clicking the locations label, a map opens that communicates the route this trip leg follows. On top of that, a short text at the bottom highlights an added value of the specific travel mode in line with the chosen Reismodus. More details regarding the specific travel mode and service provider could by the 'details' button.

Planning by "Stel samen"
The "Stel samen" plan functionality allows for composing a travel plan from scratch. Embodied as a Configurator, for each leg of the trip a choice carrousel of travel options is provided, see Figure 57.

To support learnability for novice users progressive disclosure is applied (Nielsen, 2006). By showing initially only one trip leg and a less detailed smaller version of this trip leg, only the most essential and useful features are shown. By clicking or swiping, the choice carrousel becomes in focus and trip legs are enlarged. These enlarged trip legs show more advanced interactions and more detailed information, like total cost and time as well as text highlighting the experiential value the travel mode offers.

Swiping the carrousel allows for browsing through various travel options and comparing these options easily and effortlessly. By clicking a travel option, a choice is made for that trip leg. The choice carrousel closes, and, if required, a new trip leg appears.

When no new trip legs are required anymore, the travel plan is considered 'finished'. And a summary at the bottom of the screen communicates total time, cost and experiential value of the trip. The travel plan could be evaluated and, if desired, trip legs could be adapted. Clicking "Creëer plan" navigates to the 'travel overview screen'.

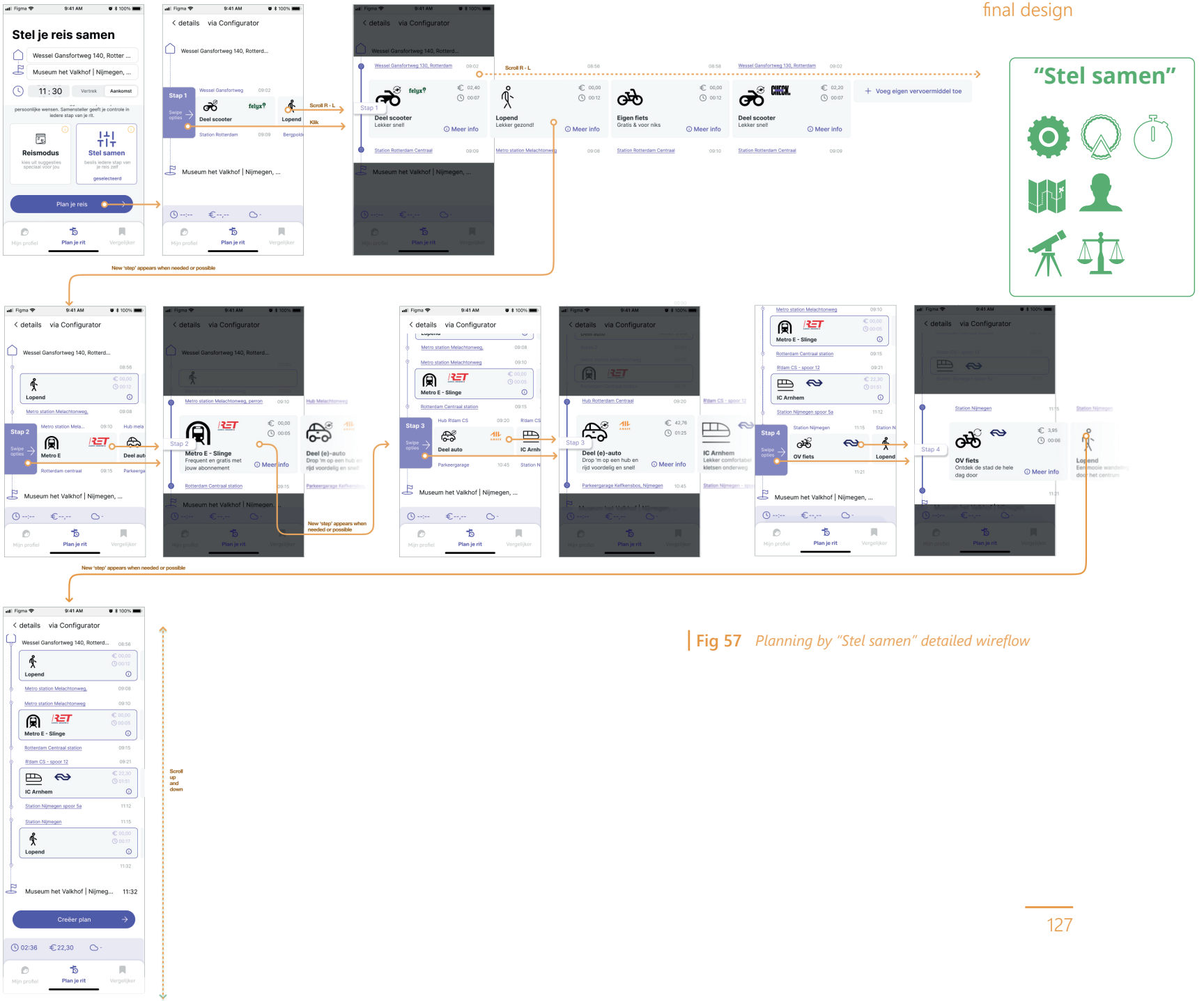


Fig 57 *Planning by "Stel samen" detailed wireflow*

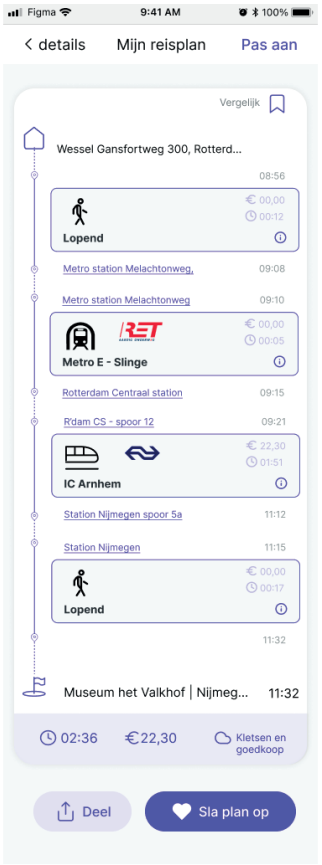


Fig 58 *Travel plan overview*

Travel plan overview

Both plan methods result in a screen showing a clear overview of the plan, see Figure 58. The screen shows a summarized version of the travel plan in one clear overview, but also provides more details when needed. For instance, the essential information and totals of a trip are presented at the bottom as a summarizing overview, although extra information about a travel provider and details on regulations of use could be found with some extra clicks.

This travel plan overview provides options to save the plan for future reference, save the plan for comparison, buy tickets - make reservations – and travel, and share the trip with someone else.

Comparing

From the travel plan overview screen, the plan can be saved for comparison, see Figure 59. By clicking the bookmark icon at the right top, an animation shows. The plan 'moves' to the "Vergelijk" functionality that is part of the bottom navigation bar. When navigating to this functionality from the navigation bar, the 'saved for comparison' travel plan could be found. All trips with the same departure and arrival destination are automatically clustered in one "Reis". When clicking such a "Reis", a screen shows all saved trips horizontally underneath each other in expendables.

These expendables are showing the various legs of the trip in icons, and shows total time and cost, as well as experiential value. When clicking the expendable, a detailed version of the trip opens.

Clicking the 'edit' button at the right upper corner allows for making changes to a travel plan.

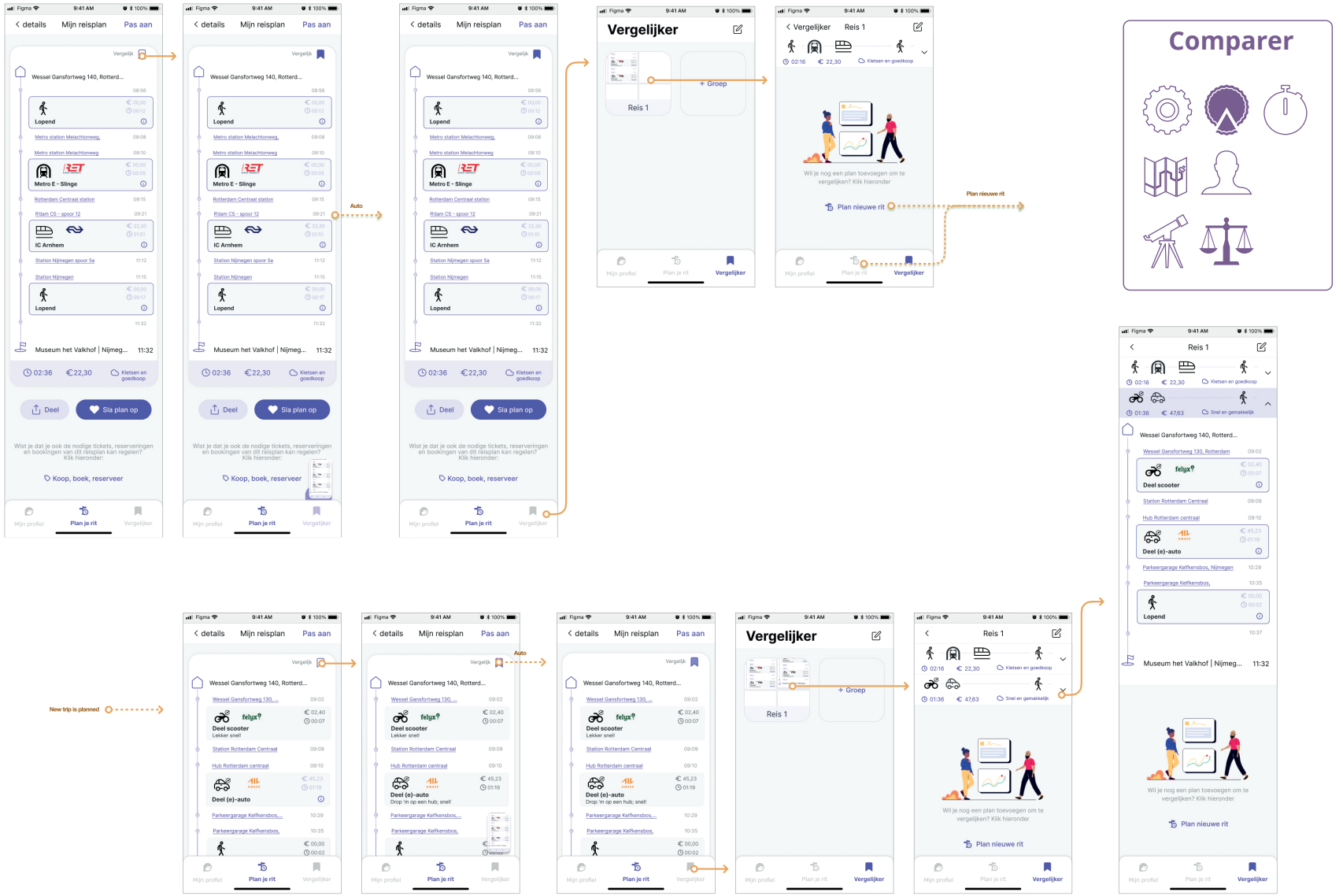
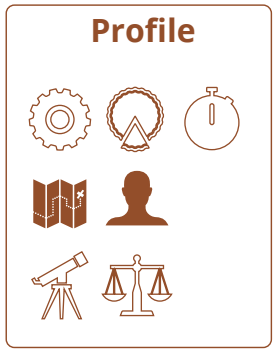


Fig 59 *Comparer detailed wireflow*



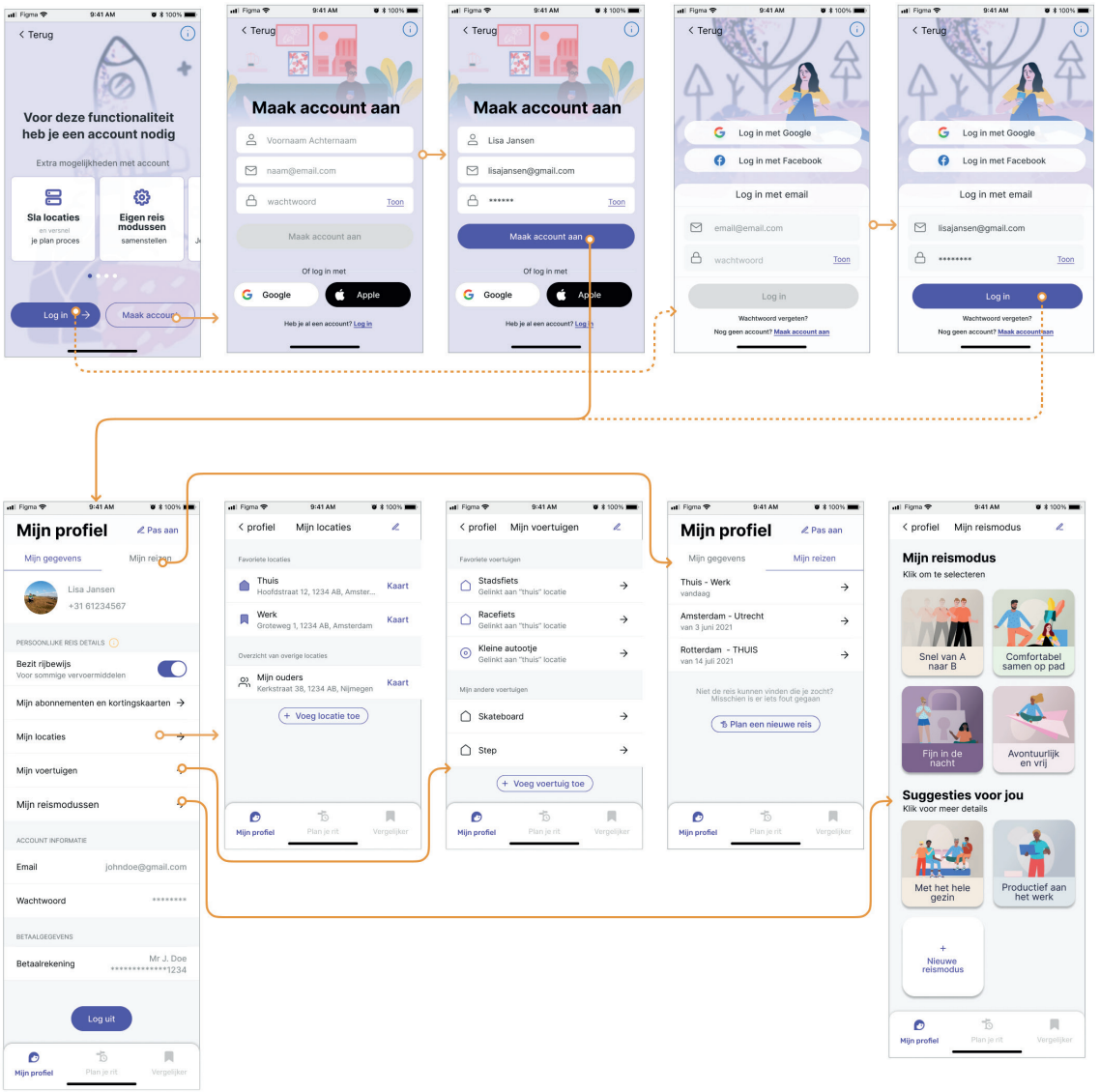


Fig 60 *Profile with personal locations, modes and subscriptions*

Profile

Whereas the application could be used on a basic level without creating a profile, to provide a certain level of trialability which supports service adoption. For some more advanced functionalities however, the use of a profile is required for storing data. These functionalities entail composing a personal Reismodus, saving personal details, adding personal travel modes and other preferences.

As illustrated by Figure 60, the moment a user encounters (e.g. clicks on) such a functionality, a short demo is shown communicating the added value and need for a profile. The user is provided the option to skip, or to create an account.

After creating an account, the profile screen shows that entails various information and options. It allows to add personal subscriptions, by which this data is translated in cost overviews and totals within a travel plan. On top of that, it could also be translated in the highlighted experiential benefit of a travel mode of a trip leg. Besides, the profile provides the option to add personal locations and travel modes, which could be interlinked and are translated into trip leg options as well. In addition, from the profile screen own created Reismodus could be found as well as created.

Create own travel mode

Whereas initially the app provides a few predefined travel plans, travellers using a profile travellers are provided the option to create a Reismodus themselves, or adapt an existing one. Either via their profile – “Mijn Reismodus” or via “Plan via Reismodus”, users enter a screen to create or adapt a Reismodus.

Figure 61 shows a variety of different setting that could be set within a Reismodus as an example. Researching and defining what specific filters and settings could and should be part of a Reismodus was not part of the scope of this project.

| 8.3.3 Visual style

The visual style of the final design is simple and aimed to function as a white label, so that both parties of the project, 9292 and RET, could use the planner functionality in their own mobile application.

The idea is that font family, primary colour and rounding of components could be altered in line with the desired branding and house style taking into account colours communicating states and validations.

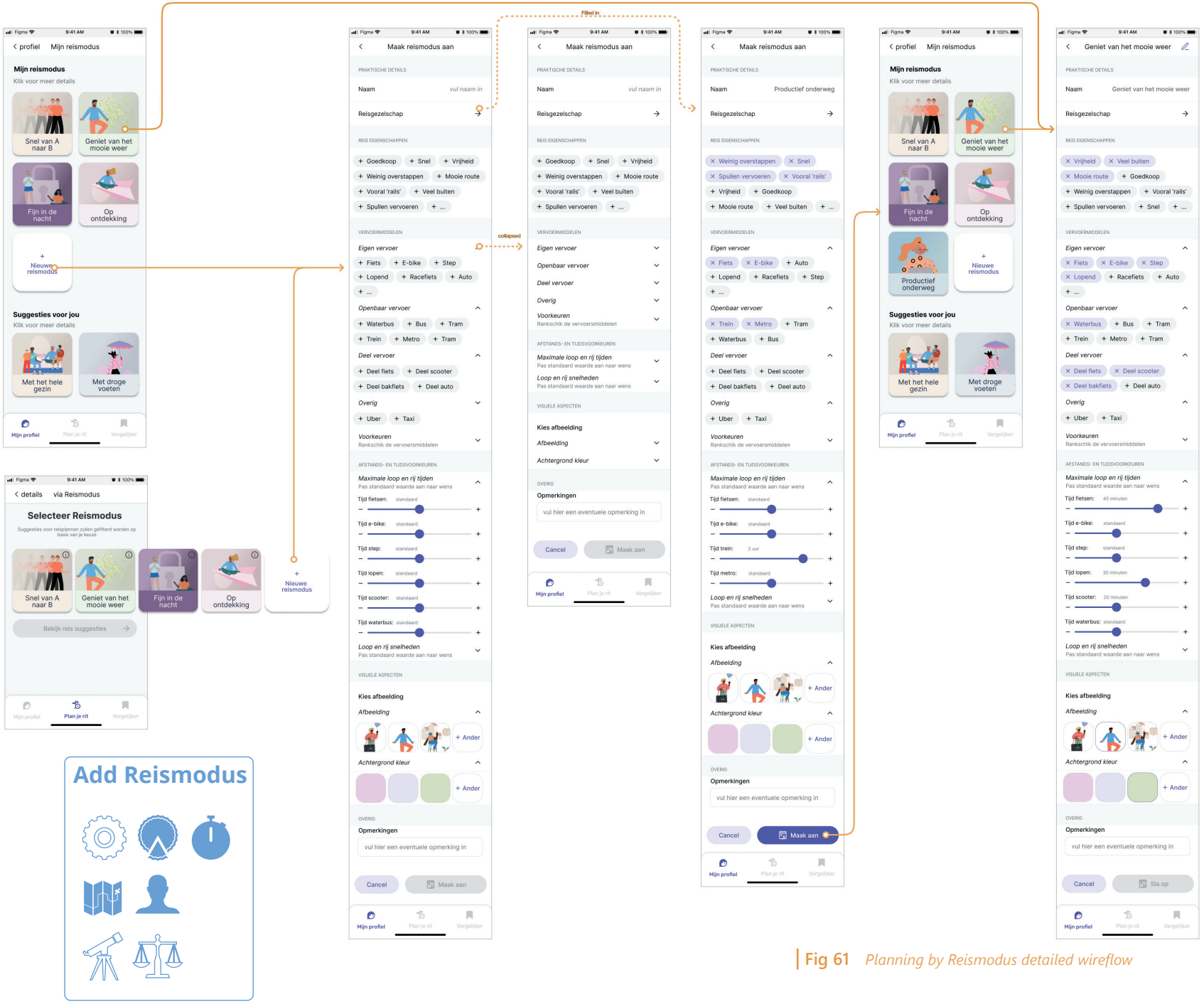


Fig 61 *Planning by Reismodus detailed wireflow*

Evaluation

PHASE

In the evaluation phase

the final design is evaluated on different levels and perspectives. It is assesed on usability and desirability with potential MaaS travellers, and evaluated on business viability, technical feasability and societal integrity with both clients as well as other stakeholders within the MaaS domain.

9 Evaluation process and methods

Main chapter insights

This chapter elaborates in detail the approach and methods used to conduct evaluative research of the final design. These activities entail guerrilla tests with travellers as well as evaluation sessions with a variety of experts on different perspectives. It discusses the tools used for prototyping, the setups and methods used for testing and evaluation sessions, and methods for analysing the data.

This chapter could be used as a reference and is aimed to support in understanding how the evaluation results presented in the subsequent chapter 10 are discovered.

Certainty is a closing of the mind. To create something new you must have doubt

- Milton Glaser

9.1
/ Prototyping

| Figma

Most of the prototypes used for the evaluation phase are built with the same Figma tool used in the design phase, see Chapter 6.3 for more information.

| Protopie

Some elements of the final design entailed video material. As the Figma prototyping tool failed to support this, it is embedded in Protopie Studio. This program is an interactive prototyping tool that allows to view, experience and test prototypes and (micro)interactions in a highly realistic way, and also supports playing videomaterial in prototypes (Protopie, n.d.).

9.2
/ Testing with travellers

| Guerilla testing

Guerrilla testing is a quick way (5-10 minutes) of testing a prototype with real users in an informal context (Ligertwood, 2020). Within the guerrilla tests carried out in this project, the goal was twofold: 1) get some insights regarding the desirability of the final design app functionalities, and 2) usability of two specific functionalities on a mobile device with an unbiased group of participants.

Recruitment procedure
Participants are recruited on the street in the centre of Delft during a weekday. They are asked to help with a small 5-minute test as part of a students' graduation project of a mobile app prototype for journey planning.

Method
As the test objectives are in twofold, two different test setups are carried out.

Desirability setup
Participants are told a scenario in which they just bought a new phone that has no apps installed. Upcoming weekend they've planned a trip to an unknown city in the Netherlands for which they desire to use a journey plan app to plan their trip. Participants are provided with a mobile phone with a Fake Door App store that shows three different plan applications. These apps show written and visual information. Participants are asked to choose and download one of these three journey plan applications. After this, they are provided with a paper form showing five functionalities and nine 'coins', and asked to 'buy-a-feature' by dividing the coins on most-wanted functionalities. If the researcher feels the participant is open to it, some unstructured and open questions are asked to discuss the app and functionalities more in-depth.

Usability setup
Participants are provided with a mobile phone that has an Progressive Web App (Kinney, 2020) installed and asked to fulfill a mission by a click test of the prototype. After this mission, they fill in a questionnaire containing the ten questions of the SUS scale. If the researcher feels the participant is open to it, some unstructured and open questions are asked to discuss the app experience more in-depth and to clarify observations during the test.

Part of these guerrilla tests are the following techniques: interactive click modelling, SUS rating, Buy-a-feature and Fake app store preference testing.

| Interactive click modelling with tasks

In general this method is similar to previously carried out tests in the design phase, see Chapter 6.3. Whereas in that phase the participants interacted with the mobile device prototype on desktop or laptop screen, within this evaluation phase it was essential to test interactions on a mobile device. Therefor, the test environment in Maze was setup as an Progressive Web App (Kinney, 2020). This makes it look and feel like a real mobile application, immersive prototype, which allows participants to experience the prototype on an actual mobile device.

Due to some technical issues, the 'desirability' setup prototype failed to load in the PWA Maze environment, therefore this test was carried out by connecting the Figma prototype in Protopie player on a mobile device.

Maze PWA
A progressive web app is a website that loads, looks and feels just like applications, see Figure 62. This Maze PWA can be installed on a mobile device providing an immersive user experience that feels like a native app on the device including the Maze testing environment setup (see Chapter 6.3), without the need to download it in the app store.

Protopie player
By connecting the Figma prototype to Protopie player, it can be tested on any mobile device. Similar to Maze PWA, this method allows for providing an immersive prototype but also supports video material (Protopie, n.d.), see Figure 63.

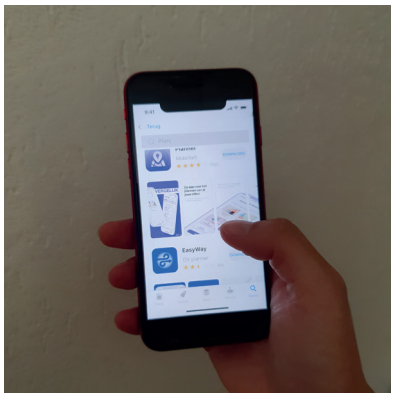


Fig 62 *Final design on mobile device via Maze PWA*

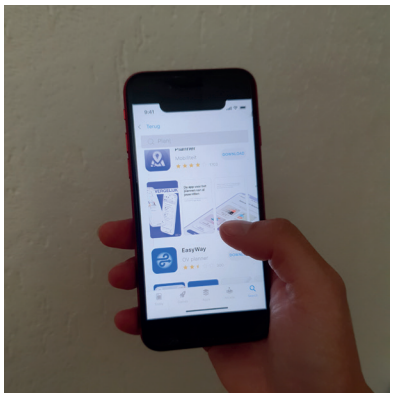


Fig 63 *Final design via Protopie player on mobile device*

| SUS

See Chapter 6.3

| Buy-a-feature

To discover some insight in the preference and priority of different functionalities from travellers, the buy-a-feature method is applied as part of the guerrilla test (Osterwalder et al., 2014). Participants were provided with a form showing five functionalities and a limited budget (9 coins) to buy their preferred functionalities with, see Figure 64. These functionalities were give a 'price', determined by a weighed input of 9292 colleagues regarding the complexity to implement and build the different functionalities.

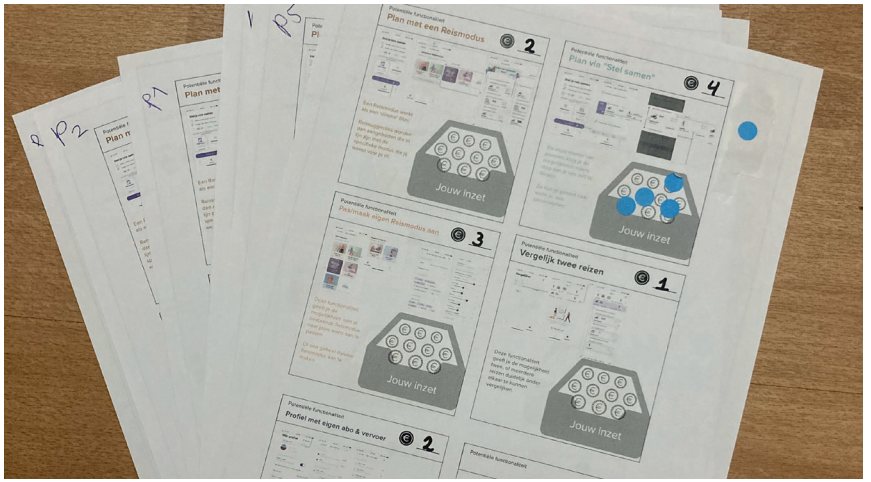


Fig 64 *example of a filled in a buy-a-feature form*

Fake App store testing

To get to some extent insight in the overall desirability of the design, a 'fake app store' test is applied as part of the guerrilla test. By means of an interactive prototype visualising the iOS App store containing three 'fake' journey plan applications. Illustrated in Figure 65, these 'apps' showed visual and textual information that aims to communicate the main functionalities of each 'app'. Introduced by a scenario about the need to download a journey plan application to plan a trip to a leisure trip, participants are provided a specific task to choose and download one of these three journey plan applications.

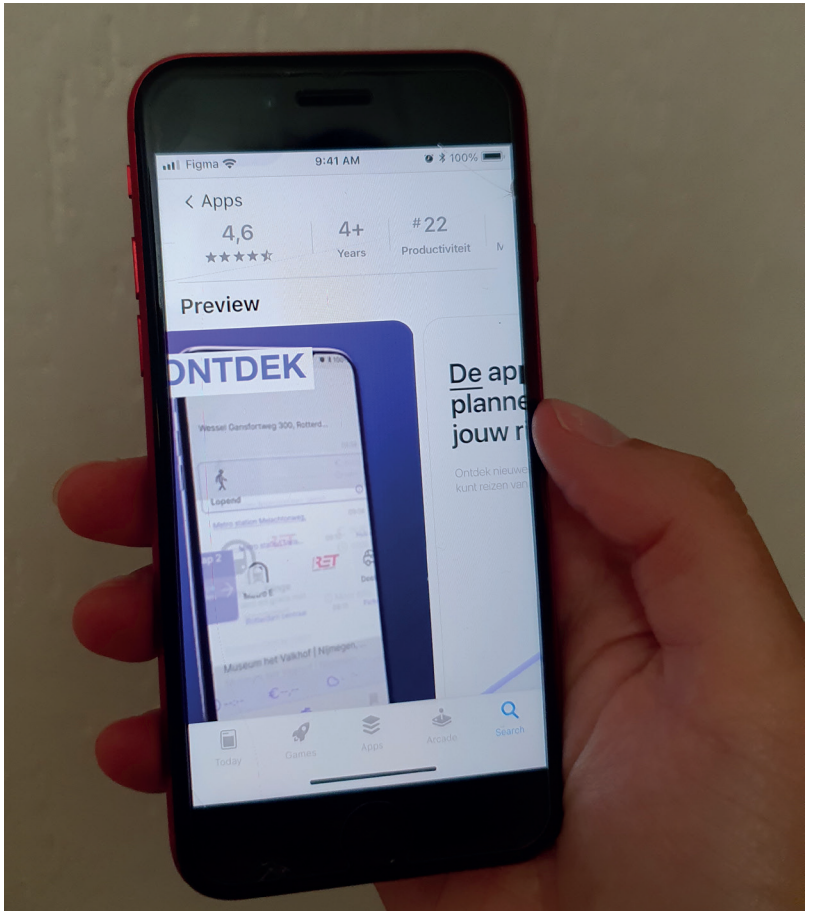


Fig 65 *Final design presented as Fake App in App store*

9.3
/ Evaluations with stakeholders

Different evaluation sessions are carried out to collect insights from variety of experts within the mobility sector. These sessions include 'stakeholder' employees from 9292 that represent the traveller, transport providers or technological part, and Marketing manager and strategists from RET. Besides, an evaluation session is held with a number of partners from the Seamless Personal Mobility Lab, which include a variety of experts within the mobility sector. On top of this, a session is held with UX design expert.

Methods used during these evaluation session elaborated next:

Fig 66 *Innovation sweet spot*

| Innovation sweet spot

Embedded in design thinking is the integration of the needs of the user, the possibilities of technology and the requirements for business's success (IDEO, n.d.). To evaluate the societal impact as a core part of the process, Integrity for society is added (Shahbazi, n.d.). The aim is to design propositions that are on the intersection of these four perspectives of innovation to add value for all.

These four perspectives are taken as a core for evaluation activities and entail Desirability for the traveller, Viability for business, Feasibility for technology and Integrity for the impact on society, see Figure 66.

| SWOT

To get input on different elements of the final design, the SWOT technique is used as part of online evaluation sessions. Guided by a timer, participants are asked to write feedback on post-its regarding Strengths & Weaknesses, as well as Opportunities and Treats the design might generate (van Boeijen & Daalhuizen, 2013).

To support participants to evaluate on a variety of perspectives within each quadrant of the SWOT diagram, within each quadrant the four different perspectives of innovation are highlighted.

| Dots

To select options for further consideration and discover argumented priorities, dots were used as a converging tool (Heijne & van der Meer, 2019). Participants are provided three dots to put on the most desired functionality.

A variant of this technique was used to get

9.4
/ Data anlysis

some insight in the (initial) level of complexity of developing and implementing the different functionalities of the final design. Rather than dots, each participants was provided with fifteen weights that had to be divided over six functionalities. The weight a functionality is given depends on (a combi of) complexity, possible risk it might induce, and the effort required to develop it.

| Design review

To ensure a digital design is easy and intuitive for your users to interact with, UX design patterns serve a great role. They are reusable design components or series of interactions that are used to solve common usability problems. Following such guidelines supports in providing a good user experience as it is for users in line with common interactions. To further improve the usability and overall design of the final design, the prototype is evaluated on UX patterns and other design related feedback with a UX design expert from 9292. On top of that, some feedback is provided to support designing functionalities as part of 'white-label-apps'.

By clicking through the prototype, an informal review session is held in which the design expert verbally elaborated on his thoughts.

| Sequencing on axis

Combining the insights from Buy-a-feature assignment carried out by travellers with weighed complexity from evaluation session with 9292 employers, a prioritisation of functionalities is formed. By sequencing the functionalities on two axis with 'Level of desirability for the traveller' v.s. 'Effort to implement', an initial estimation of quick-wins, big projects, incrementals and money pits are formulated. (Heijne & van der Meer, 2019)

10 Evaluation of final design

Main chapter insights

The final design is evaluated with travellers, and design, technology and mobility experts on desirability, feasibility, viability and integrity.

Conducting different guerrilla tests provided insights in the desire for an ‘advanced profile’ to support receive personally relevant travel suggestions and information, and a clear division of ‘Reismodus advocates’ and ‘Stel samen advocates’. Besides the different functionalities of the final design are provided an initial estimation on the level of complexity, and are reviewed by design experts on usability and UX patterns. Eventually a variety of evaluation sessions with mobility experts generated insights in the design’s strengths and weaknesses, as well as potential opportunities and threats.

I always want to completely puzzle everything out,
and discover whatever works best for me.

- Particiant1, desirability guerrilla test

By means of various evaluation activities with travellers, and design, technology and mobility experts, the final design is evaluated on the four different perspectives of innovation: desirability, feasibility, viability and integrity. Whereas Chapter 9 serves as a reference for the various evaluation methods and techniques used, this chapter discusses the main results and insights found. Chapter 11 elaborates on the overall conclusion of the project in which also the discussion of this design and recommended further steps are discussed.


Guerrilla test
Expert evaluation
Design review
Technology evaluation

10.1
/ Traveller evaluation

Fig 67 *four lenses of innovation*

| Goal

With a diverse and random group of people testing the usability of some functionalities on a mobile phone and evaluating the desirability of the app and its various functionalities.

| Method

Insights are gathered by means of a guerrilla test. As the test objectives are in twofold, two different test setups are carried out. Whereas some more information about these setups and used methods are elaborated in Chapter 9.2, a detailed version and elaborated results could be found in Chapter 13.9.1.

Participants are mainly recruited on the street in the centre of Delft during a weekday. They are asked to help with a small 5-minute test as part of a students' graduation project of a mobile app prototype for journey planning.

| Desirability guerrilla test

Participants

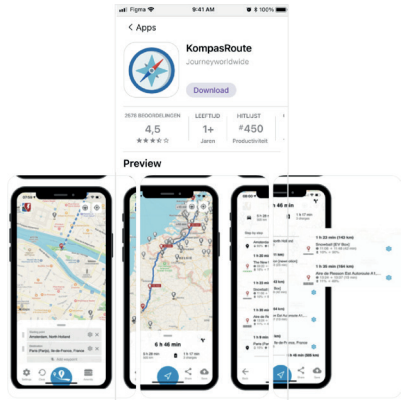
Participants recruited in th city centre of Delft, of which 4 female, three male and with an estimated age between 22 – 65+ years old.

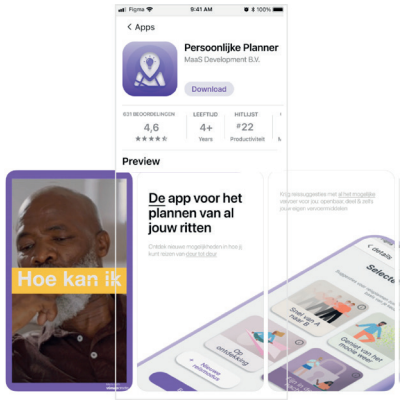
Main results

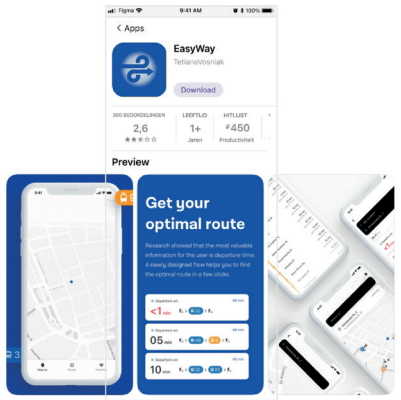
As is illustrated by Figure 67, four out of six participants preferred "KompasRoute" app over the other two journey plan 'apps'. For

Traveller
Desirability

App as a whole







Traveller
Desirability

Functionalities

I would like my own Reismodus to provide me a fun route in line with my own needs for example a route along museums or pretty parks

- P7, Guerrilla desirability test

the other two apps, both one participant 'downloaded it'. One participant expressed discomfort during this part of the test, due to a 'lack of experience with downloading applications'. Therefore, this element of the test was skipped with this participant and the results of this test element concerns a total of six participants.

Figure 68 illustrates the results of the buy-a-feature assignment, in which the colours of the coins resemble the different participants. As is shown 'Profile with own travel modes and subscriptions' is bought by all participants but one. Especially the opportunity the app could communicate what prices apply for the traveller personally was expressed to be an interesting added value.

I don't want such a Reismodus, then someone else will determine for me or even remember how I have travelled before

- P4, Guerrilla desirability test

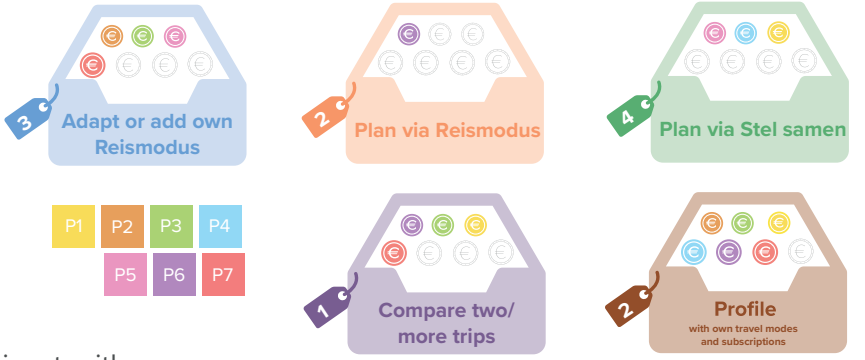


Fig 68 *guerrilla test result buy-a-feature*

On top of that, participants either bought the "Stel samen" or "Reismodus" functionality, see Figure 69. The "Stel samen advocates"expressed their preference as they experienced more control and freedom of choice than with their currently used journey planners. Although, others expressed doubts on the hassle this functionality adds due to the number of choices and effort it might take.

The "Reismodus" functionality proved to be difficult to initially understand. Once understood, participants in favour of this functionality, expressed thoughts on how it could provide them added value by coming up with some examples of desired "Reismodi". These examples were mainly focussed on adding value in terms of qualitative travel experience regarding the route. Interestingly, participants put their coins in the "Create or adapt a Reismodus" functionality rather than the "Plan with predefined Reismodus". On the other hand, some participants question this "Reismodus" functionality by expressing they might distrust the system with their personal travel data and travel mood.

Adding my own subscriptions is nice, then I can see my prices

- P7, Guerrilla desirability test

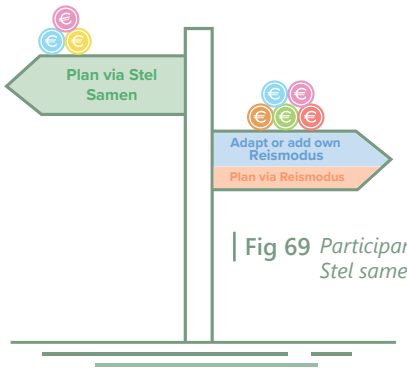


Fig 69 *Participants either bought Stel samen or Reismodus*

Traveller
Usability
2 functionalities

| Usability guerrilla test

Participants
A total of five or six participants per functionality, partly recruited on the streets in the city centre of delft, partly in the researchers' own neighbourhood or network. Of these participants five were female, four were male and with an estimated age between 24 to 60+ years old.

Main results
The results of the SUS score of "Plan with Stel samen" and "Plan with Reismodus" are illustrated in Figure 70 and Figure 71. The horizontal line resembles the testable target threshold of 68. All participants that completed the test regarding "Plan with Reismodus" scored the prototype with 75 or higher, illustrated by the green colour.

The five participants that completed the test regarding "Plan with Stel samen" are less like-minded. Whereas three scored the prototype with 73,5 or higher, one participant's results show a particularly low score of 22,5.

The "Stel Samen" plan method consist of a carrousel interaction allowing for browsing through options for a specific travel leg. In line with previous results from the design phase, this interaction was not immediately clear and caused some difficulties. Although after exploring the interaction a little further, all participants managed to find out how it works on their own and successfully completed the mission. This is also shown by the heatmaps illustrated in Figure 72 and Figure 73.

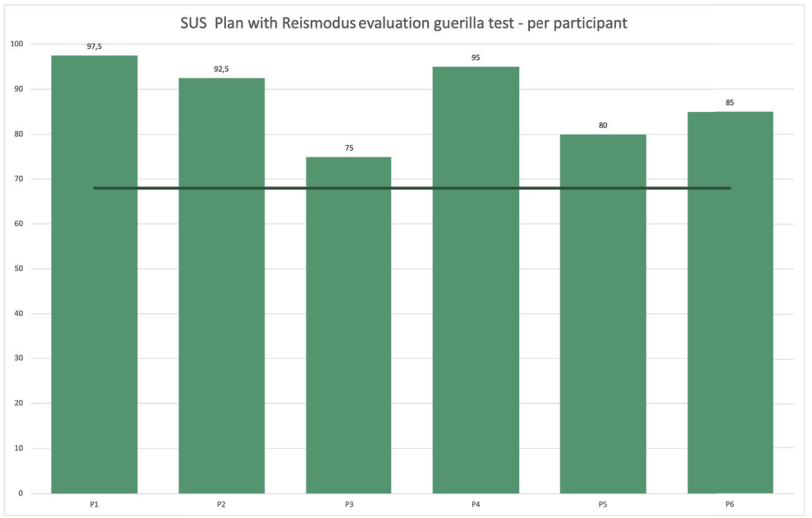


Fig 70 *SUS guerrilla test 'Plan with Reismodus'*

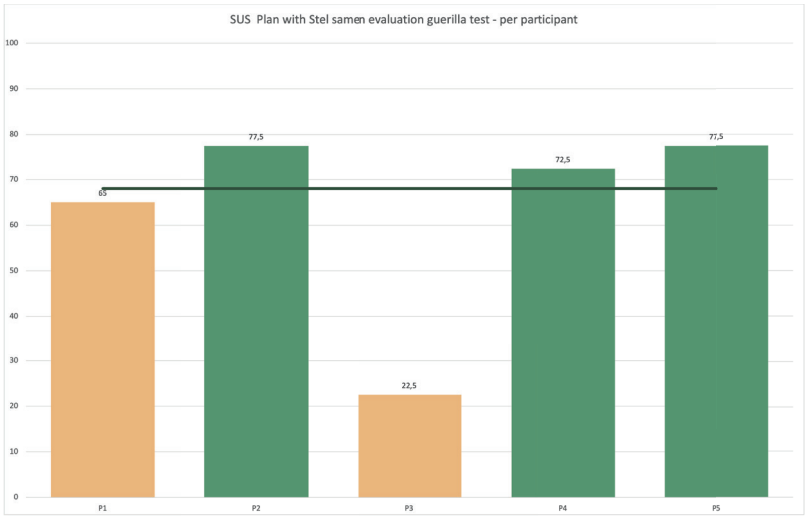


Fig 71 *SUS guerrilla test 'Plan with Stel Samen'*

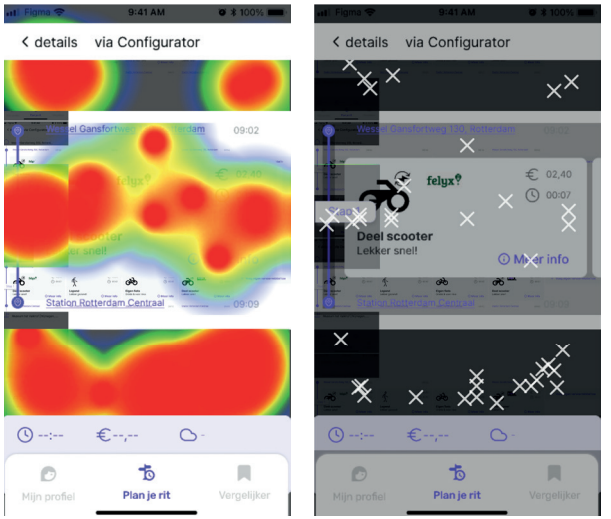


Fig 72 *Illustration of heatmap and clicks chosing the first step*

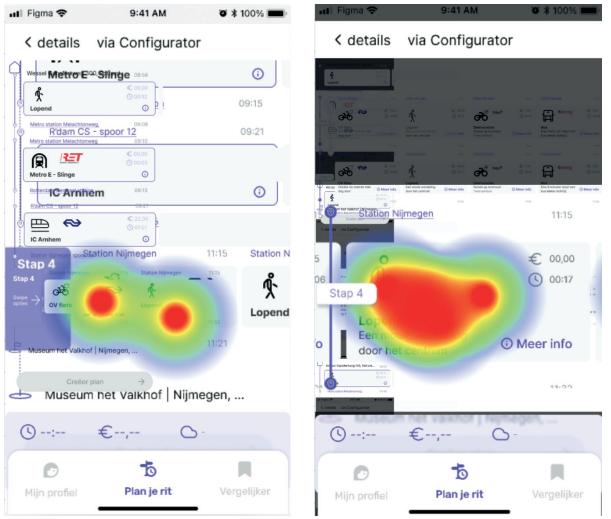


Fig 73 *Illustration of heatmap and clicks chosing the fourth step*

10.2
/ Design experts' evaluation

Traveller
Usability

Ux conventions

| Main goal and setup

Together with the designer of 9292 a design review is held to evaluate the final design regarding UX design patterns and to discover elements for improving the usability and overall user experience.

| Main results

UX conventions
In general, the functionalities were considered to be in line with conventional UX patterns. Some feedback is provided regarding low level of contrast of certain elements, see Figure 75. Besides, to improve the overall navigation to the various functionalities, the bottom navigation bar should be improved in line with the guidelines stated by for example the design system of Material Design. This states each bottom navigation bar destination should be of equal importance (Google, n.d.). Within the final design this is questioned to be the case, as the bar provides navigating to profile, plan a trip and the comparer, see Figure 76. On top of that, the most left destination should be the 'home' destination and is the one initially focussed. Within the final design the home screen is 'Plan a trip' which is the centred one.

Functionalities
Another feedback suggestion was to improve the compare functionality by combining it with the saving functionality. This 'advanced' saving functionality could limit menu entries, and overly complexing interactions.

Besides, a suggestion is given to group the buttons of share, save, ticketing and compare together in a group button to reduce complexity by the various actions in one view, see Figure 74.

White label application
The design review session conducted some feedback to support designing functionalities as part of 'white-label-apps' as well.

To design for a white label application it is important to provide the possiblility for adapting the font family, use of icons and primary & secondary colour. In general, offering freedom in only these 'few' things would allow for creating a digital product matching a company's brand and visual style. To support this, it is important to use generalized names for the various design components. For example, a specific colour should be not be indicated by their colour name, like purple, rather named 'Primary colour'.

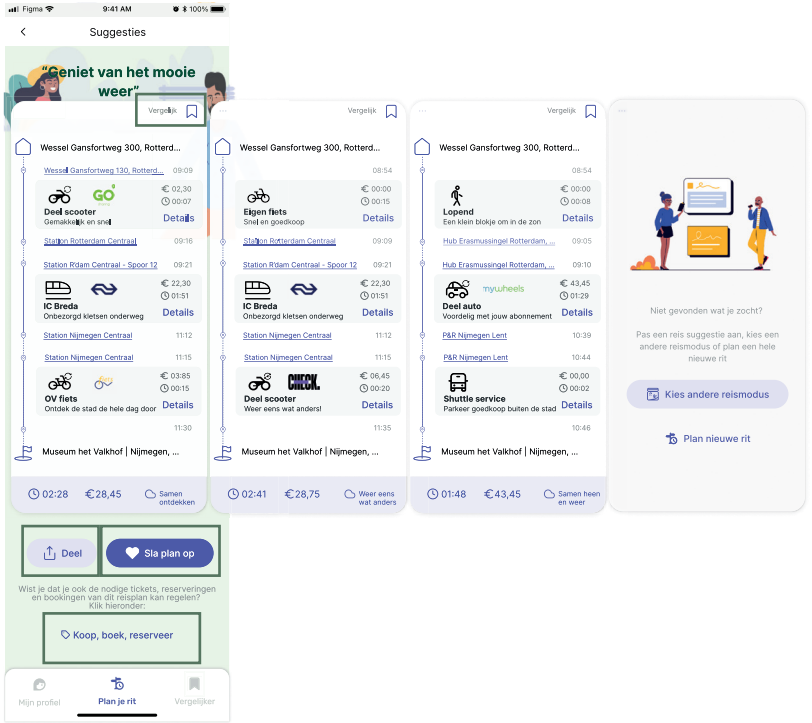


Fig 74 *Suggestion to add functionalities together*

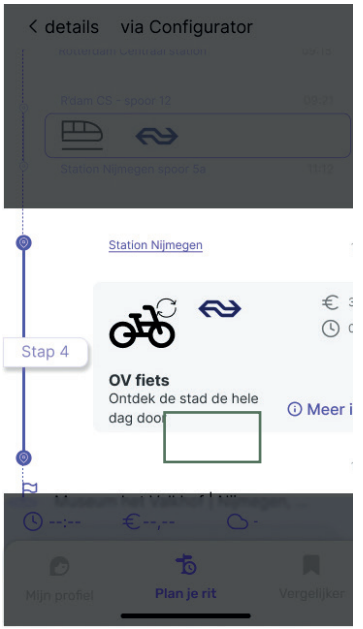


Fig 75 *example of contrast issues*

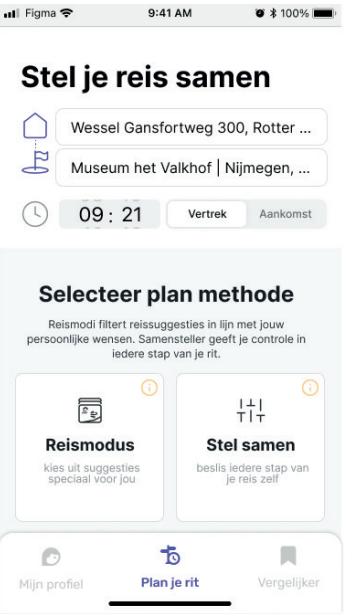


Fig 76 *tab bottom navigation*

10.3
/ Technical experts' evaluation

Technology
Feasibility
Complexity

| Main goal

Get some insight in the initially estimated level of complexity regarding the development and implementation of the various functionalities of the final design.

| Method

A team of diverse employees of 9292, are presented the final design by means of a presentation and demo. Next, they are provided with 15 weights and asked to divide the weights on six functionalities of the final design based on a combination of the estimated level of complexity, possible risk it might induce, and the effort required to develop it. The session concludes with an unstructured open discussion to clarify reasoning and considerations in a groupssetting.

| Main results

The estimated complexity of each functionality is visualised in Figure 77. As illustrated, the "Plan with Reismodus" functionality is expected to be the most complex to develop. This mainly has to do with the rate and intensity of calculations the system needs to make, while remaining to provide high performance for the user. Besides, communicating and calculating the right and relevant data of the plan suggestions themselves is mainly dependent on receiving proper input data from the various mobility service providers. As discussed in 3.3, the TOMP-API is aimed to support overcoming this challenge however by means of standardizations.

The "Stel Samen" functionality on the other hand is expected to be easier to develop. It basically functions as an advanced filter, and filters are currently already embedded. Adapting a Reismodus or creating one from scratch is neither expected to provide major challenges on a technical level. It is rather about balancing the user's desired with the level of technical complexity the system can embed. It should be decided what filters could or should be adaptable by the user. This is still something that must be researched further from a design perspective.

Regarding the compare functionality not all experts were like-minded. Whereas some stress it's relatively easy to save and show a travel plan, others express some worries. Especially updating the 'saved for comparison' travel plan with real-time data, as well as allowing users for consulting and reconsidering these plans the

travel phase might be challenging. One of the experts emphasize that no other MaaS provider managed to provide this functionality in a user-friendly way. This might indicate it entails some unforeseen underlying challenges.

To conclude, the easiest fuctionality to develop is expected to be the profile with own travel modes and subscriptions. Most of the functions are rather simple and currently already possible in the 9292 application.

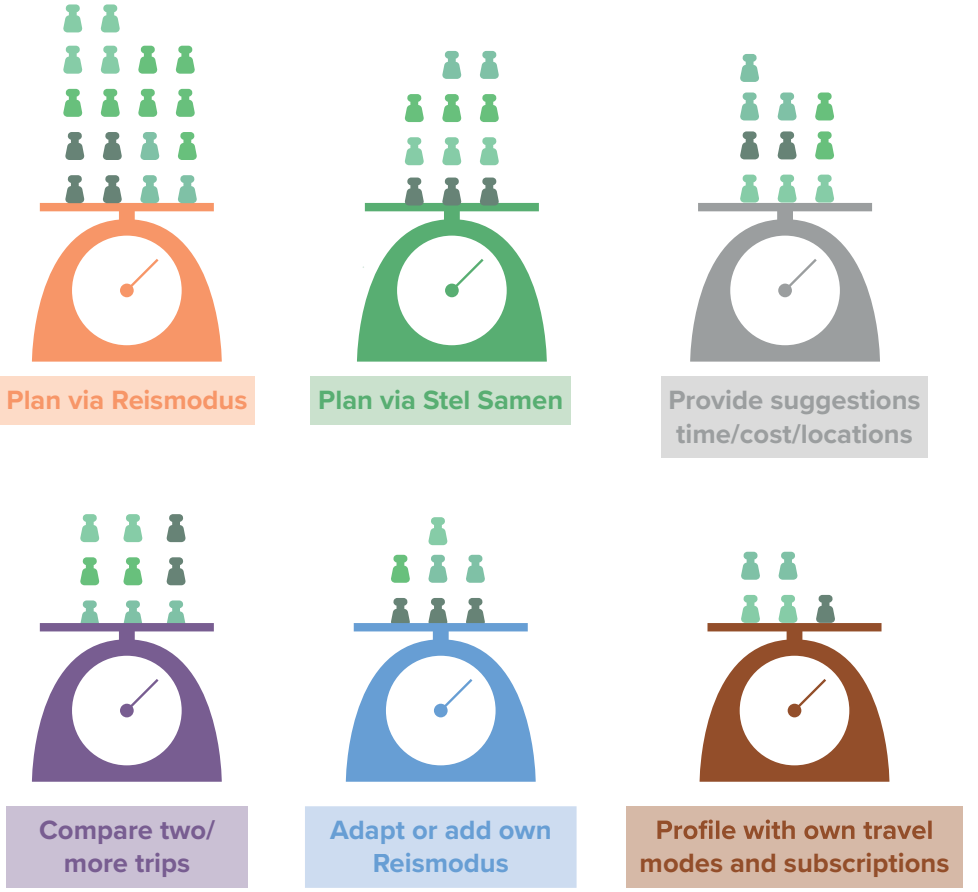


Fig 77 *estimate weight per functionality regarding development effort and complexity*

10.4
/ Mobility sector experts' evaluation

Traveller
Desirability

Technology
Feasibility

Business
Viability

Impact society
Intergrity

| Main goal

Collecting feedback on the final design from a variety of experts within the mobility sector on different perspectives of innovation: desirability, feasibility, viability and integrity.

| Method

Three different evaluation sessions are held with employees from RET, 9292 and partners from the Seamless Personal Mobility lab. Within all three sessions, the final design is explained by means of a presentation and a demo. After this, supported by a Mural brainstorm board, feedback is provided in the form of a SWOT analysis highlighting the four perspectives of innovation as well.

| Main results

Figure 78 on the next page, visualises the main and most interesting insights in the form of the SWOT analysis.

For the traveller the design was considered to provide an interesting user experience by supporting the traveller to discover new travel possibilities while remaining in control of choice. Providing personal relevant options by linking 'my locations' to travel modes and mobility subscriptions travellers own themselves, is a refreshing but relatively easy way to create a personal user experience. On the other side, the amount of choice and settings this final design currently present might overwhelm users with complexity. Adding functionalities step-by-step and using self-learning algorithms to support need-based travelling might provide interesting opportunities to overcome this complexity for the traveller.

There are however still technical challenges that the design has to overcome. There are currently many variables that induce heavy calculations, for example the large number of travel possibilities. This could create challenges to keep providing a high performance in the app service. An interesting opportunity might be to develop functionalities step-by-step and start with providing travellers with more freedom of choice in create a travel plan rather than adding more modalities in the MaaS service. In this way the focus can be on improving the algorithms and filters, and creating a solid base to further build upon.

Regarding the business perspective, the design shows interesting selling point opportunities as all mobility providers are clearly and equally presented in the plan interactions. Besides, by means of a Reismodus travel data could be discovered, and used for marketing or strategic purposes and might generate an interesting value proposition. Picking a Reismodus, in the

"Plan with Reismodus" functionality, provides some indication of a travel mood. If a traveller for example choses the modus to quickly travel from A to B, he could be hinted on some "to-go" services at stations, whereas local coffee places could be suggested when a traveller's mood is to explore and discover a new city. However, questions are also raised regarding return on investment and whether the investment in technology is worth the impact it might generate.

The final design might support a positive development regarding societal impact, as it creates opportunities to change travel behaviour by putting the conditions and requirements of the individual central. The app might seduce non-public transport travellers to travel 'differently' and might support acceptation of the changes the mobility system will go through. Although, the challenge remains to not promote the 'ease' of modalities too much as this could increase mobility as a whole. This would worsen current societal issues that are discussed in Chapter 3.

This design process shows what happens when you truly design with the user in mind and I think that is very interesting

- Gitty Schellens (marketing manager 9292), evaluation session 9292

Strengths

Discovering new possibilities while remaining in control

Personal relevance options by linked locations to owned modes and subscriptions

Translate mindset and emotion intro travel needs

Dynamic

Pleasant onboarding

Easily compare travel alternatives: no need to consult a variety of apps

Potential to seduce non-PT travellers to travel 'differently'

Can change travel behaviour, by taking conditions and requirements of the individual into account

Well feasible, although strongly depending on the power of algorithms and filters

Weaknesses

Amount of choice and settings feel overwhelming and complex

Some people travel landmark based (via map)

Personalisation seems to be a lot of effort

Often the most sustainable or active mode isn't the most profitable

Questioning investment in tech v.s. impact

Personal data: how much can or should the system know?

Challenge to seduce rather than forcing by travel filters

Support individual (car) travelling rather than public transport

Heavy calculations of large number of travel possibilities

Remaining high performance

Clear pricing from public transport

Opportunities

Selflearning algorithms to support need based travelling

Add functionalities step-by- step to let travellers get used to it

Supporting 'niche' target groups, like Vervoer op maat

Think bigger than commercial opportunities

We could act on travellers' mood (insights by Reismodus)

Selling point: all providers are clearly indicated

Means to support acceptation in mobility changes/new mobility

Reduce unsustainable impact

Respond to social support within mobility

Develop step-by-step

Start with providing travellers with more choice, rather than adding modalities

Threats

No problem and or need recognition, due to habits

Choice-stress & overcomplex

Quality of data

Many external resources/ API's need to be in place in real time

Forcing travellers, which is unethical

Promote 'ease' of modalities might increase mobility

"Poluting" public space with new mobility offerings

Many variables

If prices can't be compared, how should a user decide on a travel options

Too many functionalities without a solid base

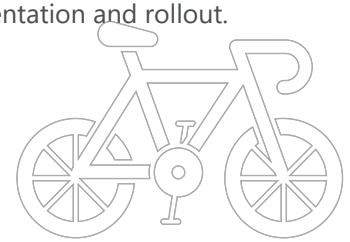
Fig 78 *Main results of SWOT analysis by mobility experts*

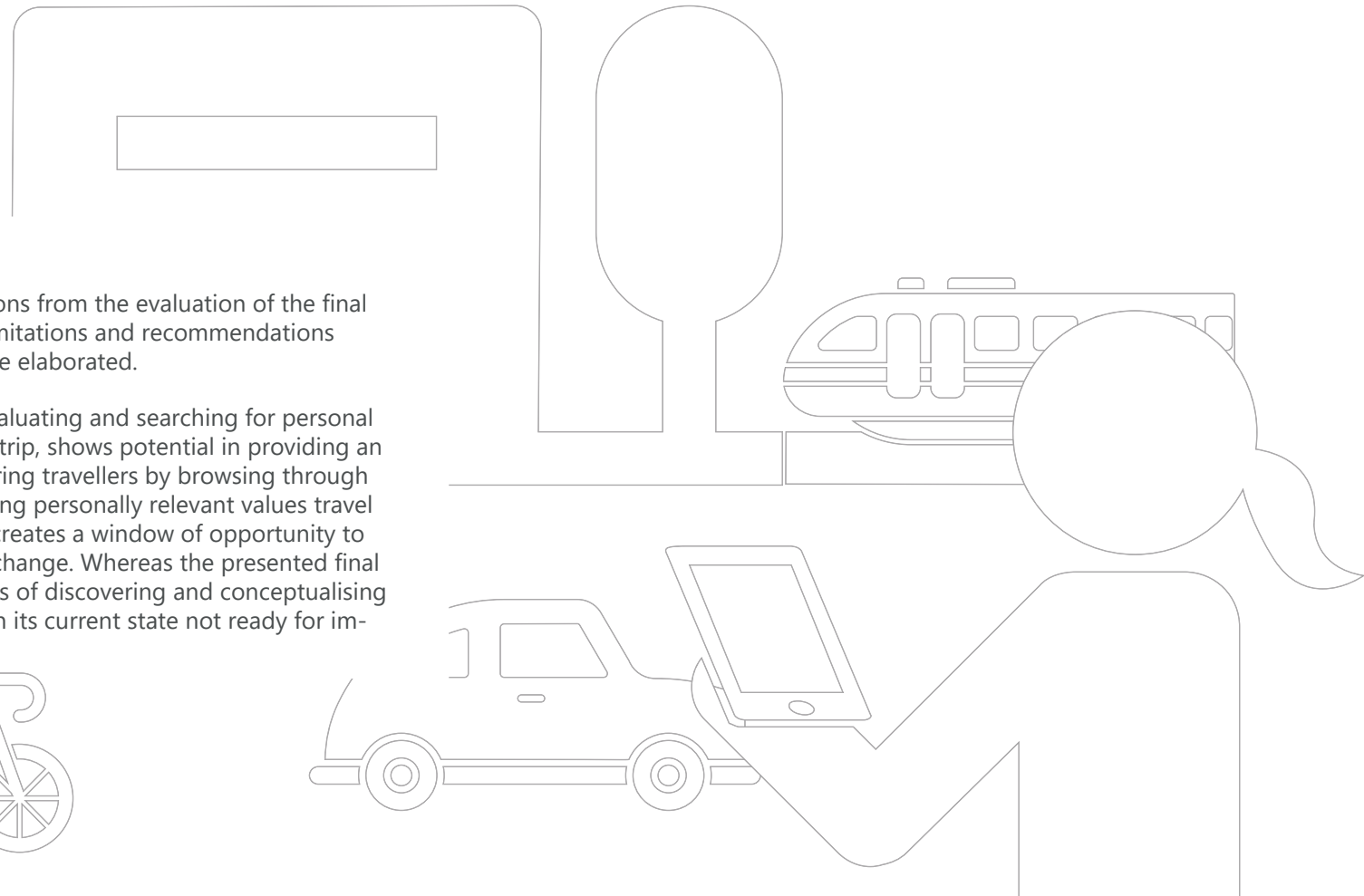
11 Conclusion

Main chapter insights

Within this chapter conclusions from the evaluation of the final design are discussed, and limitations and recommendations resulting from the project are elaborated.

Enhancing the process of evaluating and searching for personal relevant travel options for a trip, shows potential in providing an added value for MaaS. Inspiring travellers by browsing through travel options and highlighting personally relevant values travel modes might add to a trip, creates a window of opportunity to stimulate travel behav-iour change. Whereas the presented final design embodies the process of discovering and conceptualising a journey planner app, it is in its current state not ready for im-plementation and rollout.





It takes vision and courage to create
it takes faith and courage to prove

- Owen D. Young

11.1
/ Conclusion

This graduation project evolved around the process of designing of a mobile MaaS journey plan application that supports travellers with tailor-made travel advice to fulfil trip-dependent needs, when preparing a door-to-door travel plan. As a case study, the target group entailed travellers that travel to incidental leisure activities and live in an urban area with a large mobility offer (like Rotterdam). Along the line of a user-centred double diamond process, a variety of research activities and multiple design iterations are conducted with extensive user involvement. Based on the insights gained, a design of a mobile journey planner MaaS application is envisioned, prototyped and evaluated with travellers, mobility, design and technology experts.

Currently in the Netherlands, as well as many other countries, the need for transportation is increasing which creates societal challenges regarding, amongst others, the affordability of transport, the liveability of cities and sustainability of mobility infrastructure. The radical innovation that could potentially reform the entire transport system in order to tackle these societal challenges is Mobility as a Service. For MaaS to become a successful service in the Netherlands the current way the Dutch mobility system functions has to change. Moreover, travellers need to adopt the use of the system, and in a way that societal issues will actually be solved and not increased.

Therefore, on one hand the design of the journey planner application must provide travellers an added value for service adoption, and on the other hand it should create a window of opportunity for changing current travelling behaviour into more societal desirable behaviour.

From the insights gained throughout this project different things can be concluded:

Enhancing decision-making process
Enhancing the process of searching for information and evaluation activities to find personal relevant travel options for a trip, could provide an added value for adopting a MaaS service. For this, offering the possibility to browse through different travel alternatives (both per trip leg as complete travel plans) and allowing for easily and clearly comparing different travel options in one overview, showed to be important elements as it makes cross-checking various applications, to find and compare options, no longer necessary. However, solely enhancing these steps is not expected to provide 'enough added value' for all travellers to adopt. Considering the model of Dewey on consumer behaviour, see Figure 79, if travellers recognize no problem or need in current travel methods, enhancing the

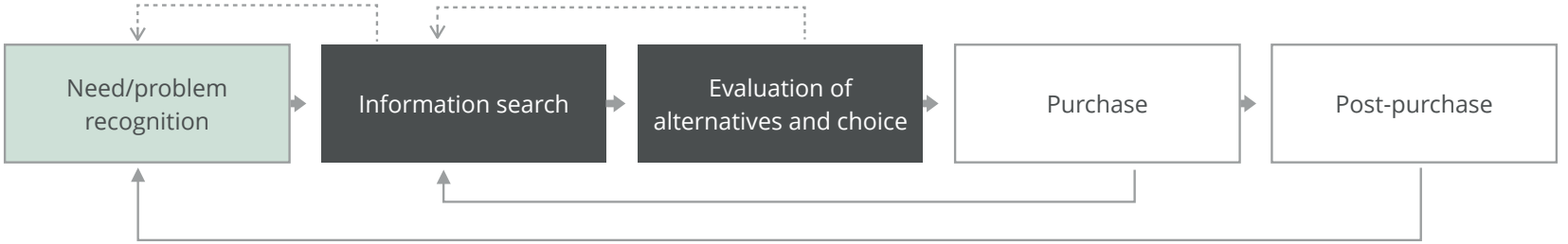


Fig 79 *Consumer decision making process by Dewey*

search and evaluation different travel mode might not be required. Therefore, these travellers might not see the need for adopting this new journey planner.

Inspire by highlighting qualitative values of travel modes
Inspiring travellers in mode-choice by suggesting a wide variety of travel modes and highlighting personally relevant qualitative value this travel mode might add to the trip, potentially allows for creating a window of opportunity to stimulate travel behaviour change. This inspiration is a way to support travellers to learn about the existence of these various 'new' options. Allowing to browse through travel options by providing clarity of cost, time as well as more qualitative values, demonstrated to be important design elements for this. Even though solely getting inspirated in possible 'other' travel modes will not necessarily translate into actions, awareness of the option is considered to be an important first step within the behaviour change process.

Next there are a few design elements that need to be in place in order to support the traveller with the process of creating a door-to-door travel plan. These are, control and freedom of choice, speed and ease, as well as personal relevance and in line with trip-dependent needs.

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Personal relevant and fulfilling trip-dependent needs
Displaying a travellers' own transport modes (linked to personal locations) as part of travel leg suggestions is highly valued. Besides, adding personal subscriptions to a profile and reflect this in an overview of travel expenses is also profoundly desirable. On top of that, highlighting qualitative value a travel mode might offer to a trip focussed on the individual himself, is valued by adding a sense of getting personal support.

Even though the use of a profile is essential for storing such data, the need to create such a profile should not be essential for (basic) app use. A certain level of trialability should be provided to support service adoption. Besides to overcome the threshold of creating a profile, the added value the use of a profile provides the traveller should be explained clearly.

Control and freedom of choice
A traveller needs to feel in control on how to travel and where to travel with. The amount of control and choice that is desired, differs per traveller and the goal this traveller wants to fulfil with the trip. Whereas some travellers desire full choice and control per leg of the trip (including route and travel modalities), other travellers

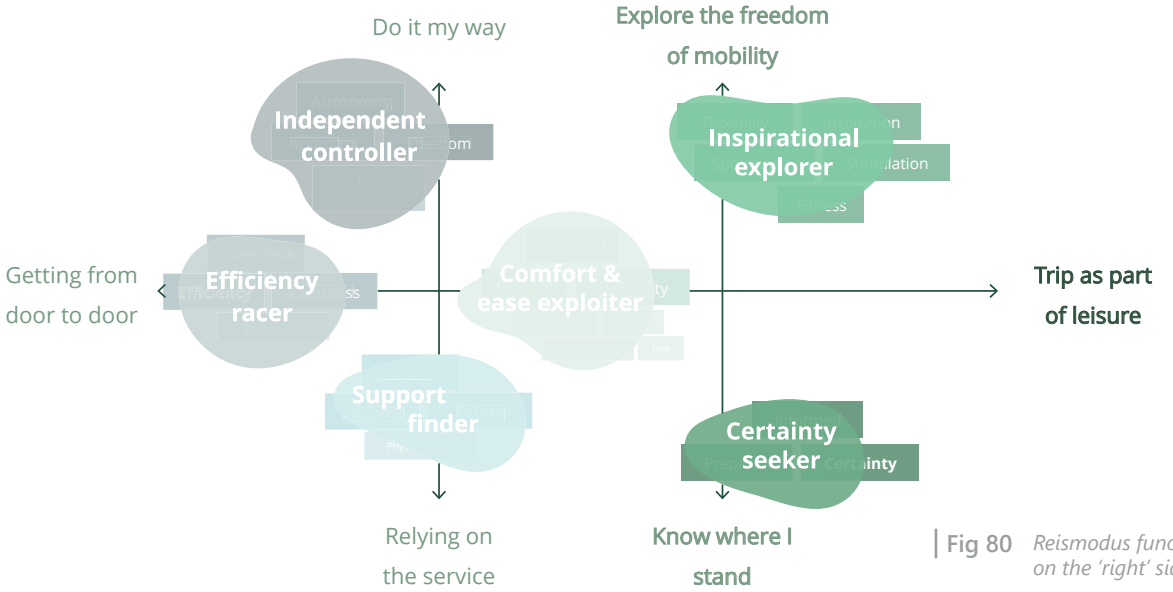


Fig 80 *Reismodus functionality for travel types on the 'right' side of the tension model*

desire choosing from a few complete journey plan suggestions.

To support the latter in quickly finding a travel plan that matches their personal and current travel needs, the use of advanced filters focussed around specific "travel moods" that filter travel plan suggestions show interesting opportunities. Within these filters, especially the use to provide qualitative added value on the trip itself is expressed. This might indicate this functionality is mainly interesting for traveller need group on the qualitative side of the tension model, see Figure 80.

> This is too complex for an app to understand, so I wouldn't trust or rely on it too much
>
> *- P5, sprint 3*

For both 'camps', however, it is essential there is a relationship of trust established between the user and the system. Especially within such an advanced filter functionality could affect travellers' confidence in the system when it's not clearly communicated what are travel options filtered 'out'.

Be aware of the level of complexity
Whereas some people consider this enhanced control and personal relevance as an added value compared to existing services, it also adds a high level of complexity to the application. This might deter people that value simplicity in a journey planner application.

11.2
/ Discussion

The presented final design should be seen as a process of a discovering and conceptualising a mobile app design, and is in its current state not ready for implementation and rollout. For this, the various functionalities presented will have to be crystallized before they are ready for development.

This project was focussed on the traveller, rather limit the creative process too much with technical and policy difficulties and/or restrictions. The project shows how a service could look like when designing up and foremost from the traveller's perspective. Whereas the different functionalities presented in the final design are promising, the research carried out in this project only indicated what people say which not necessarily proves what people will actually do. As discussed in chapter 4 the way people travel is highly dominated by habits, especially in stable contexts, and are neither rational considerations (Harms et al., 2018)

11.3
/ Limitations

A small part within the complexity of MaaS
As MaaS is acknowledged as a complex development, this project focussed to a very narrow scope to make it manageable. This also means not all challenges within the development of MaaS could be solved within this graduation project. In the next chapter recommended future steps will be discussed.

Target group as a case study
Even though the research phase discovered a diversity of traveller types travelling to leisure activities based on travel needs, this project scoped on a specific scenario as a case study regarding a resident of the region Rotterdam travelling to a city-day trip during which comfort and ease are main needs. Even though people participating during the different design tests that were part of the design phase covered a broad range of diverse people, this projects' outcomes does not prove to provide added value for all travel need types.

Potential users v.s. existing users
Considering currently MaaS is in the Netherlands little existing yet, 'exising service users' could not be researched. Therefore, research is carried out with potential users. In this, supporting these potential users in envisioning how the future service could work and add for them is crucial. However, this process of envisioning the future is difficult and could affect the depth and value of provided user insights.

Qualitative research
Throughout this project, qualitative research was central in the process. Therefore, to some level the subjective nature of analysing qualitative research and bias of the researcher has to be taken into account.

On top of that, the final evaluation with travellers is carried out by guerrilla testing. As these test sessions are short, information and depth of insights will be more limited than formal user testing. Given the speed of this method, there was no time for thorough elaboration of functionalities. This might affect respondent's input and feedback as there could be a chance that functionalities were not understood that well.

Selection bias
Especially in the early phases of this project, user research activities are carried out with limited number of participants. Besides, in some of these activities (questionnaires and creative group session) a selection bias of public transport travellers was present.

11.4
/ Recommendations

Throughout the progress of this project, I have gained broad knowledge and expertise in the MaaS domain. This subchapter describes a diversity of steps and key points I would recommended for the future. 'Take aways' and 'Put aways' are formulated for the different collaborating partners of this project, as well for other parties involved in MaaS developments in the Netherlands. Whereas Take aways resemble key points to remember and recommended activities to take on, Put aways resemble things that should be forgotten and activities that should not be undertaken in the future.

| Take aways

For all involved in setting up a MaaS offering:

- The term 'personalisation' in MaaS is vague. Rather talk about supporting travellers with mobility that is personally relevant. What is relevant for an individual traveller depends on personal capabilities as well as context dependent factors. Supporting travellers could be regarded as 'removing the need to come up with travel options and realize what possibilities they provide'.

- MaaS should support travellers in a way societal beneficial behaviour is stimulated. For example, the travel process should be enhanced and improved, although should not solely function on a self-learning system based on a persons' travel data as this might induce risk of reinforcing current 'negative' travel habits.

- And, up and foremost: put the traveller central throughout all phases of your service creation. MaaS embodies a new mobility offering, therefor aim to find added value with regard to travellers' current travel process otherwise they will not adopt.

- Take on an iterative process with high user involvement and remain flexible in changing your service offering in line with discovered needs and desires from the travellers. Don't just engage in activities with travellers about evaluative "testing of " initial ideas. Rather let them think along from the fuzzy front-end and co-create ideas by generative activities. This shouldn't have to be time consuming, expensive, or difficult. By designing, developing and testing in small steps, flexibility is ensured and supports to prevent investing time and money in something that turned out to not be the right thing to develop in the first place.

For RET:

- Do not assume the success of other MaaS services in different cultures of contexts also

mean the same product will provide success in the Rotterdam market. Different markets come with different wishes and needs, which means the use of a similar concept does not ensure success for your market as well.

- Likewise, researching and co-creation with your target group is essential for delivering a successful new service. Take on a discovery process to research the Rotterdam market, find a suiting target group and promising design direction. Engage this potential target group throughout the entire process to find a desired and unique value proposition.

For 9292:

- Whereas in its current state the final design shows promising design directions and functionalities, for rolling it out as a digital product various steps as part of an iterative development process should be undertaken. As illustrated by Zendesk in Figure 81, these phases entail design and development, validation and rollout. A first step in this development process is making an initial priority of design functionalities in line with the mission and vision of the company and possibilities. And to kickstart this prioritisation, the insights conducted by the various evaluation activities in this project are mapped on a initial desirability v.s. complexity grid, see Figure 82. This grid shows that adding personal transport modes and subscriptions as part of a profile could be a quick win! Besides, a simple version of comparing functionality as part of current 'saving a trip' screen might be a quick win as well. The 'Stel samen' functionality might provide interesting value for travellers by enhancing current level of control in shaping a travel plan. Although in its current form it challenges app performance. Whereas the Reismodus functionality indicates divergent results, I would recommend further researching and co-create with travellers how this functionality could specifically support them in a personal relevant manner.

- The evaluation activities with travellers showed communicating in the app store only one clear goal and value the MaaS planner provides is desired. Hence choose for developing either a planner that embodies an assistant providing personal relevant travel suggestions, or a planner in its most simple form. If deciding to

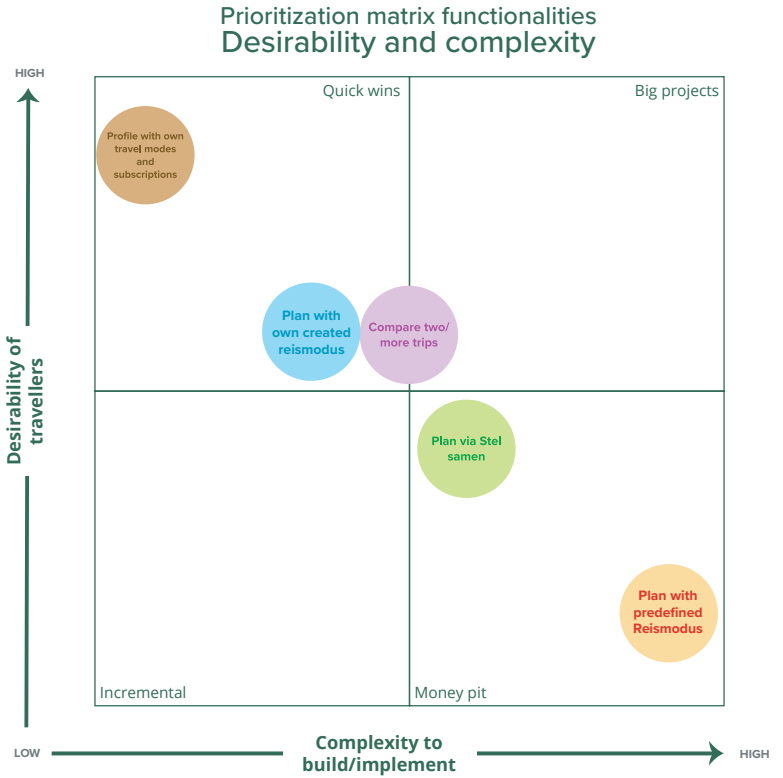
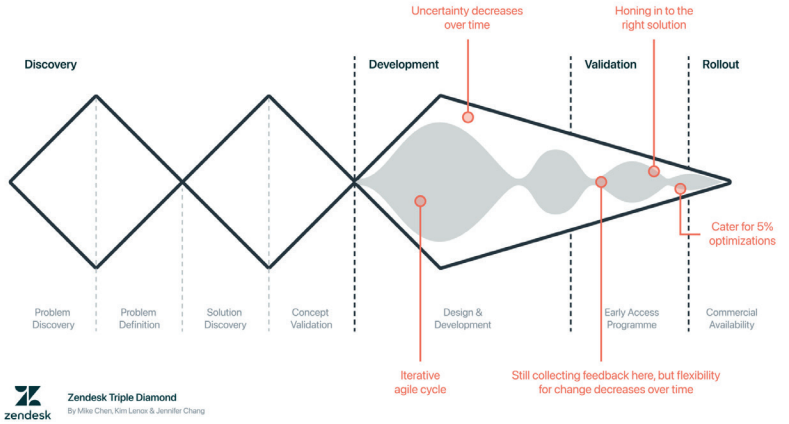


Fig 81 *Prioritization matrix of functionalities on desirability and complexity*



| Fig 82 *Prioritization matrix of functionalities on desirability and complexity*

walk both paths, I would recommend offering these via two different apps. So 'simplicity desiring users' are not deterred by the at first point of view complex-looking functionalities, and 'advanced-users' don't experience the app as not-complex-enough.

- Be aware that the new market you enter with MaaS also embodies a 'new traveller', which is not necessarily or solely the '9292 traveller'. This means knowledge of who this user is and what this user desires is probably lacking. For successful service adoption, research and explore the target group to discover ways added value for this market could be provided.

For the Seamless personal mobility lab:

- While the final design and earlier prototypes deemed attractive from the participants, this does not guarantee service adoption nor 'new' mobility offering use. There is a gap in what people say and what people actually do. Interesting project direction might be to discover: "How to support travel mode adoption or stimulate try out as a first step for behaviour change by means of a MaaS planner application?"

- Throughout various participants expressed to usually plan a trip in oppose to in one plan. Supporting door-to-door travelling is expected to accommodate for overcoming societal issues. Therefore, the challenge remains: "How to stimulate door-to-door planning, oppose to planning trips in 'parts'?"

- To make cross-checking of various applications for journey planning unnecessary, travellers need to trust that the system provides complete and fair travel suggestions. Likewise, the challenge remains: "How to establish a connection of trust between a 'smart' MaaS planner and the user?"

| Put-aways

- Involving the traveller throughout the process is expensive and time consuming, or slows down development
- I should (also) become a MaaS provider like any other
- Providing or become part of a MaaS offering solely for commercial reasons or financial interest. You are in the position to make a change, so take on your ethical responsibility to build a more future proof mobility system for the Netherlands.
- For this, also the (re)consideration what initial target group to focus on is important as currently promising early adopters might induce the risk of making societal issues bigger.
- Personalisation and providing convenience by offering a broad range of mobility offerings will make people adopt

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13 Appendix

The appendix is as a seperate appendix report. Acces to this report could be gained upon request by the researcher.

The contents of this appendix report are:

13.1 Questionnaires

13.2 Creative input session with travellers

13.3 Diary studies

13.4 Brainstorm session 9292

13.5 Sprint 1

13.6 Sprint 2

13.7 Sprint 3

13.8 Sprint 4

13.9 Scenarios