

Wellbeing in regional public transport

*Designing a wellbeing stimulating concept
for 2040 regional public transport in
Noord-Holland Noord*

Master thesis Design for Interaction
Dani Boon

TU Delft | Provincie Noord-Holland
January 2025



Title

Wellbeing in regional public transport

Designing a wellbeing stimulating concept for 2040 regional public transport in Noord-Holland Noord

Master Thesis

January 2025

MSc. Design for Interaction

Faculty of Industrial Design Engineering

Delft University of Technology

Author

Dani Boon

Supervisory team

Chair

Euiyoung Kim

Design Organisation and Strategy

Designing Value In Ecosystems

Mentor

Elmer van Grondelle

Human Centered Design

Design Aesthetics

Company mentor

John Steendijk

Provincie Noord-Holland

Foreword

This masters thesis is the final project in my journey as a Design for Interaction student at the TU Delft, and with it, my journey as a TU Delft student as a whole.

When I first stepped foot in the Industrial Design Engineering faculty, I had no idea what I wanted, and where I would end up. Now, some few years later, I am very happy with the road I took, and am proud of what I achieved and where I ended.

Therefore, I hope you enjoy reading my thesis, and I hope something in it resonates with you, and inspires you.

Acknowledgements

While this project was done by myself, I would not have been able to do it without the help and support of several people.

I would like to thank my supervisory team, Euiyoung, Elmer and John, for their continued feedback, support and encouragement. Thank you for helping me manage not only my project, but also myself. I have thoroughly enjoyed working with you.

Massive thank yous go out to my partner and family for unwaveringly supporting me throughout these highly chaotic months.

I would also like to thank my graduating friends. Our joined working sessions, as well as our coffee talks have really helped me get through this project.

To all friends I have yet to mention, thank you for the good times, allowing me to take my head off of this project, and truly unwind at times.

Finally, I would like to thank all participants, colleagues, experts and more, who have participated and shared their experiences and knowledge throughout this project, and through it, helping me arrive at the final concept.

Executive summary

How can public transport go beyond moving people from A to B, and instead be something that actively fosters human wellbeing? That question is leading as this thesis explores and addresses the challenges of mobility and accessibility in Noord-Holland Noord, a non-urban area of the province of Noord-Holland, the Netherlands, where public transport often fails to meet the needs of the travellers and residents there.

This project, conducted in collaboration with Provincie Noord-Holland, envisions a design for a 2040 regional public transport system that prioritizes traveller wellbeing over operational efficiency.

The project follows a design process rooted in the Vision in Product Design method, supplemented by theory of Fundamental Needs and the usage of user personas, to enable a future oriented but human centered approach that integrates the needs of the users into a future concept design.

In the initial research, literature review, observational studies and user interviews were used to gain a baseline understanding of the context and users. Findings revealed a lack of accessibility and user satisfaction, as well as a risk for social isolation and car dependency.

Using these insights, a current day worldview was sketched, supported by five user personas, which could be used in combination with a trend and development analysis to develop future scenarios with user profiles. These scenarios highlight risks of over-optimization and social isolation in and outside of public transport. They also propose an alternative, more desirable vision instead, one of social vibrancy and a community oriented

public transport system. A mission was then formulated to design an intervention to encourages travellers to reach out and connect with the people and the world around them, and to realize the desired vision.

Through various steps of ideation, development and iteration, the 2040 concept, Sociaal-waardig OV, is designed, a reimagined public transport system which transforms public transport into a socially enriching experience. The proposed system is built on three core elements:

1. Empowered Hosts: Bus drivers evolve into community hosts, fostering positive interactions and creating welcoming social environments.
2. Inviting Spaces: Creating dynamic (buses), static (hubs), and digital spaces that evoke warmth, inclusivity, and connectivity.
3. Seamless Supporting Network: Background technologies handle logistics like payments and scheduling, allowing travellers and hosts to focus on meaningful social interactions.

Validation through discussions with experts highlighted the system's alignment with regional goals of Provincie Noord-Holland towards social connectivity and accessibility.

Finally, to guide implementation, a roadmap is proposed, providing guidance towards future steps over three time scale, aligning with three concession periods (2018 – 2028, 2028 – 2038 and 2038 – 2048) towards gradually integrating the redesigned system, before scaling, expanding and evolving the system. Additionally, design guidelines are given as well to aid in adapting the core ideas of this project into different contexts and design challenges.

Table of contents

Foreword	2	The 2040 vision	36	References	74
Executive summary	3	Vision in Product Design	37		
Table of contents	4	Creating a future filter	39	Appendices	84
Glossary	5	Future situation	44		
Introduction	6	Mission and vision	48		
Project approach	7	Conclusions	52		
Preliminary research	10	The 2040 Concept	54		
Literature review	11	Ideation	55		
Observations	19	Sociaal-waardig OV	59		
Interviews	22	Integration roadmap	63		
Visions of the province	25	Concept validation	65		
Conclusions	26	Conclusions	67		
The 2024 situation	28	Concluding	68		
Current context	29	Design guidelines	69		
Current personas	31	Recommendations	71		
Conclusions	34	Reflection	73		

Glossary

This is an overview of some important concept or abbreviation found in this thesis.

Community bus

A smaller bus, part of the public transport network, but driven and organised by voluntary organisations.

DEPEST

A framework to classify research areas, abbreviation of Demographic, Ecological, Political, Economical, Socio-cultural and Technological.

First/last mile

The first of last steps in a journey, typically between a part of a transport network to the destination.

Fundamental Needs

A theory developed by Pieter Desmet and Steven Fokkinga in 2020 that proposes 13 fundamental needs that are used to understand and explain the needs of people.

Hoogwaardig Openbaar Vervoer (HOV)

High-grade public transport focussed on fast, high frequency and comfortable transport connections.

Noord-Holland Noord

The northernmost area of the province of Noord-Holland, consisting of 17 municipalities.

Openbaar Vervoer (OV)

Public transport.

Provincie Noord-Holland (PNH)

The governing body of the identically name province of Noord-Holland.

Public Transport Accessibility Level (PTAL)

A metric developed by the Borough of Hammersmith and Fulham in 1992, used to assess the quality and accessibility of public transport.

Vision in Product Design (ViP)

A design methodology developed by Paul Hekkert and Matthijs van Dijk in 1995, used to design an underlying vision for a designed intervention.

Introduction

I grew up in a small town in the north of Noord-Holland. When I was young, I would bike to school, to friends, basically everywhere. When I was old enough, I got my driver's license, broadening my transport options, and with it, my world. In this time, I think I could count the amount of times I took the bus on a single hand.

I am now living in Delft, often taking the bus, trams and my bike interchangeable. However, when I visit my family I still won't take the bus there, opting instead to call on my parents for a ride. I have the luxury of being healthy, and having family members who are willing to give me a ride. Others might not have that luxury.

Doing a master's thesis is a requirement, but focussing on the topic of public transport in the non-urban areas of Noord-Holland was my own choice, as I had realized the disparity between the mobility options there, and in the Randstad. I saw an opportunity to try my hand at finding a solution or remedy, and wanted to take it.

The goal of this project however is not simply to design a first/last-mile mobility option. Instead, I want to design something that actively aims to increase the emotional wellbeing of travellers. This project will be done in collaboration with Provincie Noord-Holland, the governing body of the identically named province of Noord-Holland.

Project approach

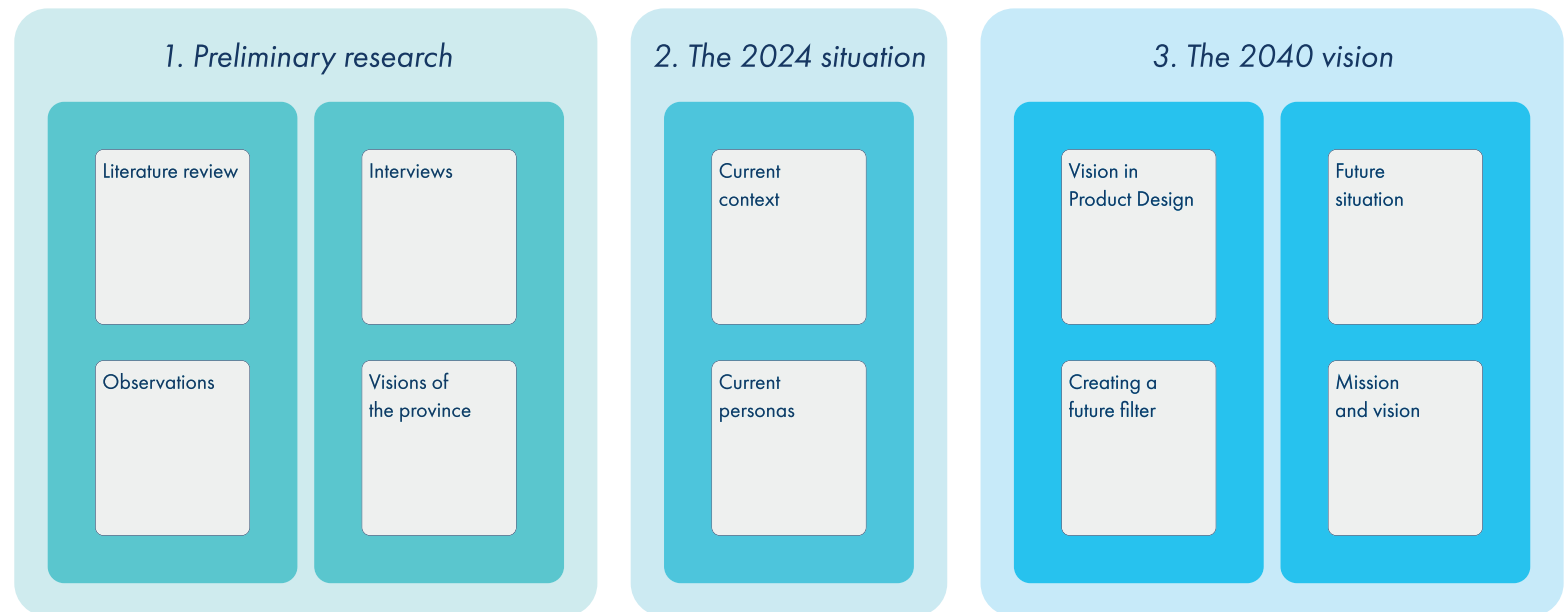
The structure of this thesis, as well as the process followed throughout this project are explained here. Additionally, a brief summary of the contents of all chapters is given for quick navigation.

The design process of this project largely followed that of the ViP (Vision in Product Design) method (Hekkert, Van Dijk, 2016), which will be explained in detail in chapter 3, The 2040 Vision. Supplementing this method are elements of the Fundamental Needs (Desmet & Fokkinga, 2020) framework, as well as personas. This allows the process to be future focussed, breaking away from iterative design and current day restrictions, while also allowing the key insights from the user research to aid in maintaining a user-focussed in the process.

Report outline

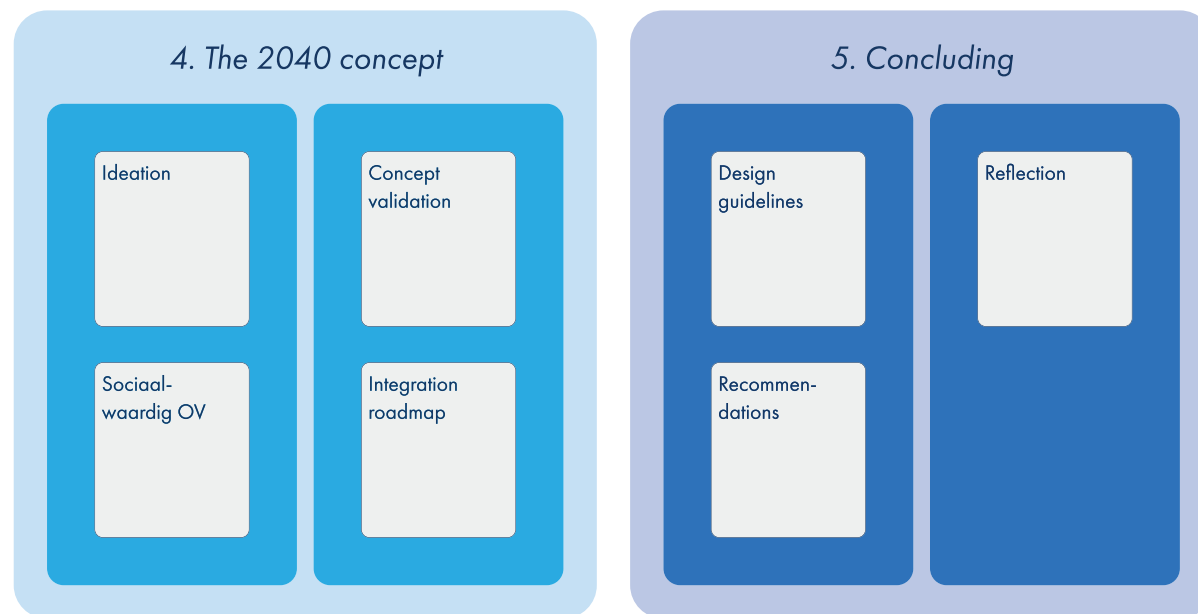
Chapter 1 covers the various methods of research utilized to gain insight into the current users and context of use, as well as the existing future visions from Provincie Noord-Holland, to define the project goal and scope. Chapter 2 follows up on these insights, compiling them into the formats of a narrative and personas to be used in later steps.

Chapter 3 covers an extensive trends and developments analysis to be used with the VIP method, which can be combined with the contents of chapter 2 to define the context and the user of 2040. Based on this, a vision is defined for the goal and interaction of the designed intervention.



In chapter 4, this vision will be used in combination with the 2040 personas to ideate and iterated towards the 2040 concept, Sociaal-waardig OV. Additionally, a roadmap is proposed for the implementation of the system.

Finally, chapter 5 gives design guidelines and recommendations for further steps, before a personal reflection concludes the project.





1. Preliminary research

Introduction

Before a design could be made for a yet unknown far future scenario, first a thorough understanding of the current day scenario must be created. By researching the many facets that contribute to the state of this current scenario, and identifying the problems at play in the region, the goal and scope of the project can be defined.

To gain this thorough understanding, different methods of data collection were used to not only create a broader understanding of relevant topics, but also to create a deeper understanding of specific factors and elements.

Contents

This chapter highlights the topics researched through literature review, as well as the insights gained from observation research and interviews. It also provides an analysis of several visions proposed by Provincie Noord-Holland, before concretely stating the identified goal of this project.

1.1 Literature review

To kick off the research phase, a literature review was first conducted. Here, data was collected through various sources, such as reports, scientific papers, (news) articles. Additionally, other designers and experts working at Provincie Noord Holland were consulted to identify relevant topics to research.

The literature review focused on the three main themes of this project: public transport, wellbeing, and automotive technology. Below, the chapter presents the theory used for further defining the scope and goal of this project. Research that was later used for creating the future filter can be found in Appendix D.

Regional public transport

The first topic of research revolves around the geographical context. Research focussed on the area itself, public transport and the quality thereof and mobility options in the area.

Urbanity

The scope of the project is initially defined as the non-urban areas of Noord-Holland. However, as this definition is quite broad and nondescript, it was required to create a definition of non-urban Noord-Holland that would be used within this project, and with it, a concrete

definition of what areas of Noord-Holland this further project would focus on.

To that end, the definition of urbanity as given by the Centraal Bureau voor de Statistiek (CBS, 2024) is used. This definition uses the average address density, classifying urbanity as follows:

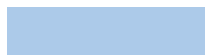
- Very strongly urban: more than 2500 addresses per km²
- Strongly urban: 1500 to 2500 addresses per km²
- Moderately urban: 1000 to 1500 addresses per km²
- Faintly urban: 500 to 1000 addresses per km²
- Non-urban: less than 500 addresses per km²

By then cross referencing this definition to the address density per municipality in Noord Holland (calculated by taking the amount of addresses per municipality (Allecijfers, 2024) and dividing it by the surface area per municipality (Wikipedia, 2022)), the urbanity of Noord-Holland and its municipalities can be determined, as shown in figure 1 on the right.

Based on the urbanity of the individual municipalities, as well as those of the administrative regions, the scope of the project can be narrowed to better suit the definition of non-urban Noord-Holland. Therefore, the geographical scope of the project is redefined as Noord-Holland Noord.

Legend

Non-urban



Fairly urban



Moderately urban



Strongly urban



Very strongly urban

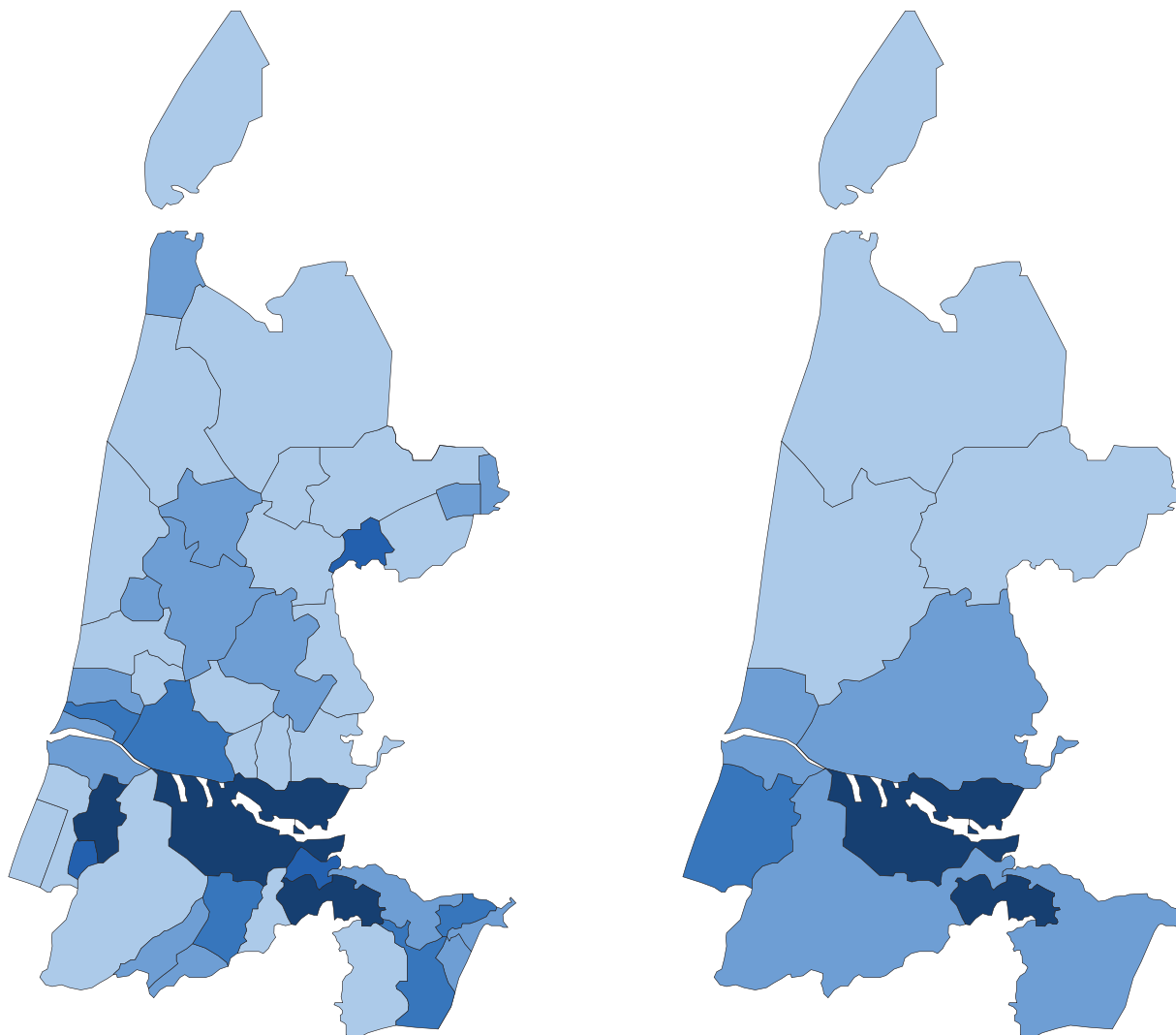


Figure 1. Urbanity in Noord-Holland per municipality (left), and per administrative region (right).

Public transport accessibility

To gain insight into the accessibility of the public transport network in Noord-Holland, research was done towards the average distance from home to the nearest public transport stop, both including and excluding train stations. The findings of which (found in appendices B and C) roughly aligned with the urbanity of the region, with areas of lower urbanity requiring farther distances to be travelled to reach the public transport network.

However, while this method for qualifying the accessibility would work in theory, it neglected a significant element contributing to the accessibility, namely frequency of service.

Thus a different method of assessing the quality and accessibility of the public transport method was sought. To this end, the framework of the PTAL score, or Public Transport Accessibility Level was referred to.

The PTAL score, originally developed by the London Borough of Hammersmith and Fulham in 1992, is a method of assessing public transport that reflects the distance from point of interest to public transport, the reliability of the services, the number of services available and the average waiting times.

This metric is adopted and used by Transport for London (TfL, 2018) as a means to assess public transport service in London, and also been used by Kennisplatform CROW (CROW, 2023) to assess public transport service for each municipality in the Netherlands. Through revisualisation of the data acquired from Kennisplatform CROW, as well as restricting the data to only include the municipalities in Noord-Holland, the accessibility of public transport in Noord-Holland can be represented in figure 2.

Much like the assessment of accessibility based purely on distance, the findings align with the urbanity of the region, showcasing how there exists a relation between the urbanity of the region and the quality of public transport.

Legend

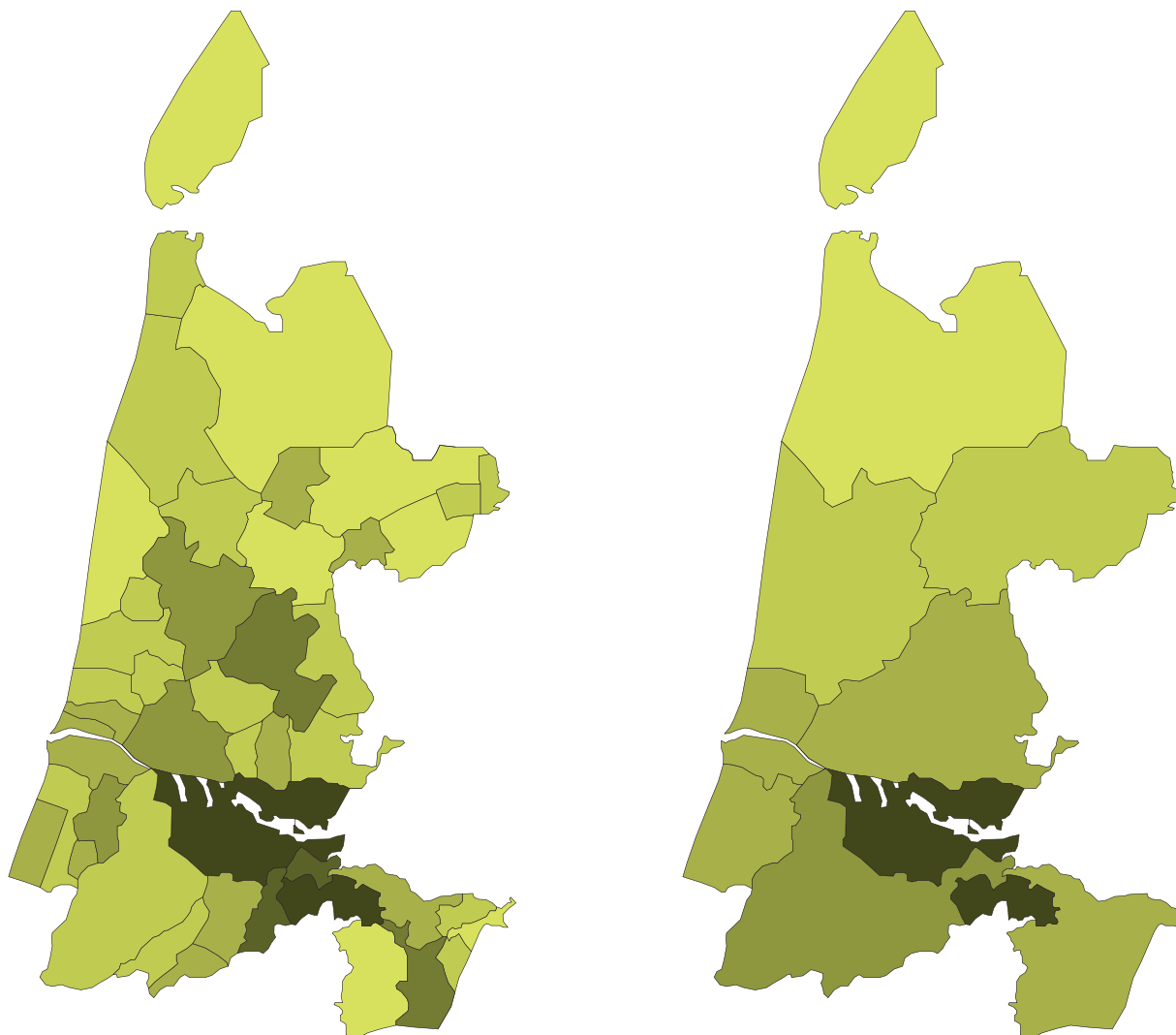
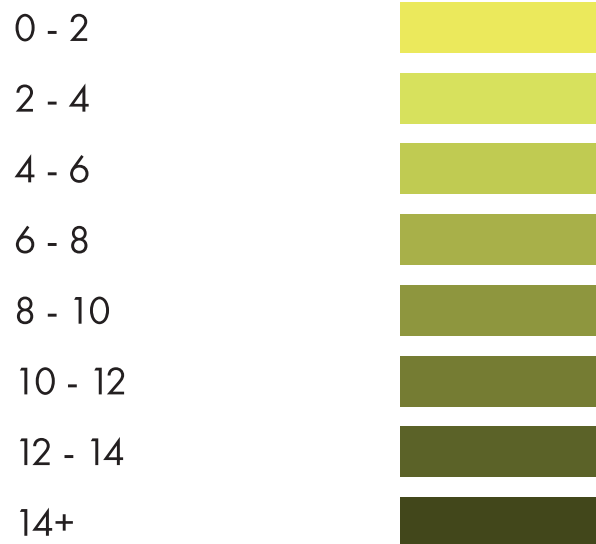


Figure 2. PTAL-score in Noord-Holland per municipality (left), and per administrative region (right).

Concessionaire

The operation of regional public transport is not done by the government itself, but instead done by a concessionaire, a company that holds official permission from the government for the right to operate the regional public transport. This permission lasts for ten years, after which a new concessionaire is chosen in process where the companies tender for the concession.

The offers of the companies are evaluated then by the government based on various factors, including costs, quality of services and network coverage. The government may also demand specific requirement, such as the operation of specific lines. After evaluation, the highest scoring company is given the right for the operation of the regional public transport in the coming 10 years (Wikipedia, 2024). The current concessionaire in Noord-Holland Noord is Connexxion, which holds the right to operate until 2028 (OV in Nederland, 2024).



Figure 3. Current concessionaire Connexxion.

The concessionaires create a transport plan that seeks to balance the travel needs of the region against the costs of operation. As a result of this, bus lines that operate in areas of low demand could be run less frequently, or disbanded all together. This explains the lower PTAL score in lower urbanity areas, as demands are not high enough to justify increased service.

In cases where the lines are disbanded all together, and thus where there is no regular bus service, other organisations, often volunteers, to step up to provide service to the residents and travellers. Within Noord-Holland Noord, there are eleven volunteer community bus organisations, maintaining twelve bus lines.



De Drieban
Buurtbusvereniging

Figure 4. Community bus organisation De Drieban.

Transport options

Within the region of Noord-Holland Noord, the public transport travel options are quite limited for the travellers. While there is a limited number of train routes, these routes only connect the larger cities, and the occasional villages in between, which still leaves the majority of Noord-Holland Noord unconnected to the larger public transport system.

Instead, the majority of Noord-Holland Noord is connected through the bus network. Here, Connexxion utilizes several types of busses to execute their transport plan.

Name	Description	Deployment
<i>Tribus Civitas</i>	The Civitas is a small sized (7m) diesel powered bus	Deployed for the more quiet city lines, as well as community lines
<i>VDL MidCity Electric</i>	The MidCity is based on the same platform as the Civitas, but electric rather than diesel	Deployed as city service in Hoorn
<i>VDL Citea LLE-99 Electric</i>	The Citea LLE-99 is a medium sized (9.9 meters) electric bus	Deployed for both city lines, as well as regional lines
<i>VDL Citea LLE-120</i>	The Citea LLE-120 is a medium sized (12 meters) diesel powered bus	Deployed for both city lines, as well as regional lines
<i>Solaris Urbino IV 18</i>	The Urbino IV 18 is a articulated large sized (18m) diesel powered bus	Deployed for regional lines
<i>Solaris Urbino IV 18 CNG</i>	The Urbino IV 18 CNG is a hybrid variant of the Urbino IV 18	Deployed on Texel



Figure 5. The Tribus Civitas driven on community bus line 412.

Besides the bus service, smaller services like micro mobilities and shared mobilities are available near the larger cities and hot spots, while their presence in the less urban areas are near non-existent.

This limited array of options, combined with the lacking coverage of the public transport network itself breeds car dependency amongst residents. A report published by the Kennisinstituut voor Mobiliteitsbeleid (KiM, 2022) indicates that Dutch residents in non-urban areas feel increasingly dependant on cars, with 47% strongly agreeing with that sentiment.

Adding to this, one in three residents feel that car ownership isn't a choice, but a necessity. This issue compounds with the fact that in many regions in the Netherlands, (public) facilities are disappearing, leading to an increase in the minimum distance needed to travel to reach these facilities.

Wellbeing

The second topic of research explores wellbeing in the context of public transport, and introduces a framework which helps to identify and design for wellbeing later in the project.

Relevance of traveller wellbeing

In recent times, increasingly more consideration is given to the wellbeing of the traveller, both during, and outside of travelling time (Delbosc, 2012). Research shows that travelling influences not only momentary emotional wellbeing, but that it also has direct and indirect effects on overall life satisfaction (Friman et al., 2017). Additionally, further research then shows that these effects are not limited to the time spent travelling, but extend beyond that, both prior to, and after travelling (Liu et al., 2022)(Chatterjee et al., 2020).

Furthermore, research also indicates that overall travel wellbeing is more important than travel satisfaction alone in travel choice behaviour (Wang, 2022), which suggests opportunities in placing wellbeing as a central element in the design process.

These factors highlight the importance of designing for traveller wellbeing, and that this design should not be isolated to a single step of the journey, but extend beyond it as much as feasible, and aim to create positive lasting effects.

13 Fundamental Psychological Needs

Since wellbeing is a broad topic, with many interpretations and frameworks to identify it by, one of these frameworks had to be selected to be used within this project. For this, the methodology of the 13 Fundamental Psychological Needs (Desmet & Fokkinga, 2020) was chosen for its bridging of design and psychology theory, and for my previous experience in working with the framework.

This methodology proposes that every human, regardless of lifestyle, age or culture, has the same 13 fundamental needs, and that fulfilling these needs lead to physical or mental wellbeing. It also notes that neglecting these needs will have an adverse effect on wellbeing, and that compensating for one fundamental need with another not being an option.

Through the use of this framework in the context of this project, we can better identify the needs of the users, and in the design phase, purposely steer the design towards the satisfaction of these needs, as well as attributing meaning to the design and its interactions.



Figure 6. 13 Fundamental Psychological Needs typology (Desmet & Fokkinga, 2020).

1.2 Observations

To gain a better understanding of the users and their behaviours within the context, two observational studies were conducted. These studies allowed for the capture of key interactions within the real context without intervention or prompting the travellers, and thus allowed traveller to exhibit natural behaviour.

Plan

For the observational studies, two bus lines and their direct surroundings were selected in Noord-Holland Noord, these being line 416 driving between Schagen and Kreileroord, and line 412 driving between Hoorn and Bovenkarspel. Both studies were conducted over the span of a day.

In these studies, observations were focussed on a few areas. The first being the travellers themselves, and their behaviours in and around the bus and bus stops. The second being the buses and bus stops themselves. The final point of focus were the interactions amongst the travellers, and between the travellers and the buses, the bus drivers and the bus stops.

Finally, care was taken to interact with, or otherwise prompt the travellers that the behaviour observed would be as natural as possible.

Findings

During the observational studies, several interesting and valuable insights were gathered. These, along with various pictures taken during the observational study, are detailed below.

Social drivers

Besides the obvious role of driving the bus, it quickly became apparent that the bus drivers also fulfilled a very social role. Greeting passengers and passerby's and making small talk was a common occurrence. Furthermore, on one instance mistook a greeting from a passerby as them hailing the bus, and stopped. This ended up being a miscommunication, but a laugh was had, and the bus took off again.

As the driver is a member of the community who volunteers to drive the bus, their desire to help the residents shows through, for example when stopping outside of a regular stop to pick up a traveller.

The stops, shelters and stations

The quality and quantity of bus stops varied greatly, with some stops clearly receiving more resources than others. The majority of the stops along bus lines 416 and 412 only had a pole signalling the bus stops, with only a handful actually having a shelter with place to sit. These shelters were naturally concentrated on the hotspot along the bus lines, with the stops in the truly rural areas sometimes not even having a paved platform.



Figure 7. Bus stops shelters and stations along line 412.

Part of a larger journey

More often than not, the journeys are taken as a single step in a larger journey, rather than a standalone journey. However, due to the limited service with buses only driving the lines once per hour, it can be a considerable challenge to align the bus with further steps in the journey, leading to long wait times, sometimes devoid of even the simpler comforts like shelter and seating.



Figure 8. Bus stop at train station Anna Paulowna, where the time to wait for the bus was more than thirty minutes.

Cosy or lonely

Due to the smaller size and capacity of the community bus, as well as the fact that it is driven by a voluntary community member, there is big opportunity to create a warm and more intimate experience. However, the bus itself is almost industrial and clinical, and not stimulating for cosy conversations.

Adding to this sentiment is the positioning of the seating in the bus, with a wall creating a physical barrier between the driver and passengers, and the tall passenger seats creating isolating bubbles for the passengers. Combine these different elements that are making communication more difficult, and this cosy and intimate bus can start feeling incredibly lonely and cold. Especially when there are no other passengers, which tends to happen often due to the low demand.



Figure 9. Interior of the community bus, devoid of passengers and with the driver blocked off by a physical barrier.

(No) incentive to take the bus

In general, with the limited reach of the bus, the infrequency of the rides, the hard to align schedules and the lonely experience, there are a lot of factors dissuading the passengers from taking the bus, and instead encourage the use of alternative modes of transport where possible.



Figure 10. Dirty information sign, only cleaned when necessary.

1.3 Interviews

To gain a deeper understanding of the travellers themselves, as well as their behaviours, their needs and potential struggles, in depth interviews were conducted. These interviews helped in more clearly identifying the underlying motivations of the travellers.

Plan

For the interviews, six participants of three different demographic groups (student, working, retired) were sourced. These demographic groups were based on the travellers observed in the observational studies. Besides the demographic groups, the participants were also selected on the fact that they lived and travelled, either by public or personal transport, in Noord-Holland Noord.

The interviews took between 30 and 60 minutes, and featured open questions to allow for more insightful answers, as well as follow up questions. There was a protocol that was followed, yet the interviews were allowed to deflect from this protocol to allow for a more natural conversation to arise.

The interview was roughly divided in six sections, starting with an introduction, followed up by questions related to the participants' backgrounds. Then, questions were asked related to the participants' travel behaviours and motivations, before their perceptions of public transport were asked. Finally, the participants were asked about their struggles and challenges regarding travelling.

Participant	Occupation	Place of residence	Reason to travel
Participant 1	Student	Alkmaar	School in Alkmaar, visiting friends living close
Participant 2	Student	Tuitjenhorn	School in Alkmaar, visiting friends living close
Participant 3	Working	Grootebroek	Work in Amstelveen, Visiting family and friends living close
Participant 4	Working	Hoogkarspel	Work in Anna Paulowna, visiting friends living close
Participant 5	Retired	Alkmaar	City trips, visiting family living further away
Participant 6	Retired	Alkmaar	City trips, visiting family living further away

Findings

Like the observational studies, the interview generated additional interesting insights, highlighted below. Additionally, some quotes of the interviewees are shown as well.

Freedom or comfort and security?

One of the topics that came up across all participants was the consideration that had to be made for each journey. Public transport could provide more comfort, convenience and security than personal transport, but for this some freedom would have to be sacrificed, making the choice not as easy to make. There also isn't a guarantee that it will be more comfortable and convenient, as full buses and trains during rush hour quickly diminish the value gained by traveling by public transport.

Efficiency is (not) everything

It is clear that efficiency is valued amongst travellers, yet not for the same reasons. The working participant noted that they valued the opportunity to work while in transit, rather than spending that time simply travelling. The students valued efficiency in not 'wasting' their time. On the other hand, the retired participants noted that efficiency was less important if the journey was pleasant and comfortable.

"I can just take a seat in the train and be free of all hassle."
- Participant 5



No consideration needed


Through the interviews, it became clear that while in some situations the choice between personal and public transport wasn't easy to make, there were several situations where either option was not even a consideration. For the retired participants, this was when visiting relatives, something that in their eyes could not be done with public transport, while the students noted that with heavy rainfall taking the bus was a no-brainer.

"I sometimes feel like I have no choice but to take the car. Well I do, but it's not a reasonable choice to do otherwise."
- Participant 3



The experience of efficiency

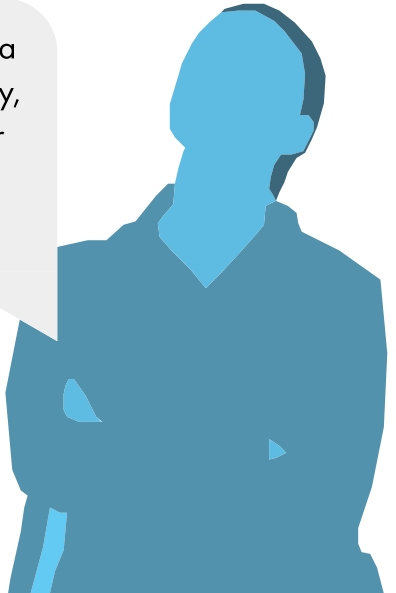
In a less connected region, regional public transport may operate based on a central hub, often located in the biggest city. This could mean that to get to the next town over, a significant detour was required first, which several participants noted to find weird and unpleasant. However, one participant countered this point by noting that taking the bus, even if not faster than taking the bike, feels quicker and more efficient.



"It's very remarkable that you can get to every part of the Hague with bus or tram, and in Noord-Holland you can't even get from village to village because there just is nothing."
- Participant 2

Trusting the system

A final point of note that came up in all interviews was the trustworthiness of the system. A bus or a train getting cancelled might only be a slight inconvenience for the retired participants who travel for pleasure, but for the student it might mean missing a class, and the working participant may no longer be able to work due to the overfilled bus or train. It is also considered common knowledge to never take the last scheduled bus, since the risk of not getting home is too high. While the chance for this happening is low, the risk makes it hard for the travellers to fully trust the system.



"Public transport here leaves a lot to be desired to put it kindly, and its deeply saddening for certain municipalities."
- Participant 4

1.4 Visions of the province

Provincie Noord-Holland (PNH) has defined various visions regarding the direction and strategy for the future of Noord-Holland. These visions provide guidance towards the goals of PNH in a general sense, but also more specific to Noord-Holland Noord, and to public transport and mobility within the province.

Visions

Provincie Noord-Holland regularly publishes documents which highlight its vision on the area, and its future. Here, three of those documents, and their relevance to this project are summarised.

Omgevingsvisie NH50

The omgevingsvisie details how PNH seeks to balance economic growth with creating a safe and healthy living environment. It aims to pursue this objective through various ecological efforts, with the transition being guided by innovation and sustainable development, aiming to ensure mobility that is healthy, efficient, effective, and inclusive.

Hubstrategie provincie Noord-Holland

The hubstrategie describes how PNH aims to protect the vitality and livability of the villages and cities in the province through efforts towards fostering accessible and sustainable transport, fighting congestion and transport poverty, and offering sustainable mobility alternatives.

Ontwikkelperspectief OV Noord-Holland Noord

The ontwikkelperspectief details how PNH intends to ensure that the region remains accessible and inclusive to all through enhancement and optimization of the public transport network. It also acknowledges and is proud of the value and strength of the communities, and its willingness to support one another, and wants to keep fostering these communities.

Summarized vision of the province

The visions of the province outline how Provincie Noord-Holland strives to keep the region safe, healthy, accessible and inclusive by ensuring effective, efficient, sustainable and innovative mobility for all. In this, it seeks to protect and enhance the vitality and liveability of the region, as well as fostering strong and connected communities.

1.5 Conclusions

To conclude the preliminary research, the identified problem is stated once more, and with it, the goal of the project is clearly defined as well.

Conclusion

The mobility problem plaguing Noord-Holland Noord is twofold. On one hand, there are people who aren't reached by the local public transport network, and instead are forced to resort to alternative methods, such as personal transport, or end up being unable to travel at all.

On the other hand, there are people who are reached by the local public transport network, yet their needs remain unfulfilled, leading these potential users to once again seek alternatives, or refuse using public transport at all. Here, not every traveller encounters the same problems, yet each traveller experiences pain points in their journeys, sometimes enough to dissuade them from using the local public transport network altogether.

Still, local public transport possesses the potential to do more than just transport people, it also has the potential to have a lasting positive influence upon their lives and wellbeing. Therefore, based on the research, the goal of the project is defined as follows.

Provide a connection between the traveller and the further public transport network in a way that stimulates traveller wellbeing.

Key insights

- Travelling by public transport has to provide some sort of value over personal transport for travellers to choose it.
- The drivers of the community bus inherently have a social role besides their role of driving the bus.
- The community buses actively create bubbles through the placement seatings and barriers. Through this, the bus driver is cut off from the passengers as well.
- Provincie Noord-Holland realizes the strength and value of the communities in Noord-Holland Noord, and wants to foster these.



2. The 2024 situation

Introduction

After collecting various pieces of information on current situation and the factors playing a role in it, it can be summarized and formulated into a format that would more easily allow it to be used in later steps.

The current context covers the region, and more importantly, the problems that are experienced here. The current personas aim to represent the five types of travellers identified, as well as explain the behaviours, needs and struggles that characterize them. Finally, the traveller journey shows the journeys that the travellers experience step by step.

Contents

In this chapter, the information found during the preliminary research will first be consolidated into a detailed description of the current context. Then, five personas will be defined to represent the travellers, before the traveller journey will be detailed.

2.1 Current context

The chosen context for this project is Noord-Holland Noord, the northernmost region of the province, and the most non-urban part of it as well. Here, a strong sense of community empowers the residents to support and feel supported. Yet while life here can be considered more quiet and removed from the heftics of the city, it is not without its own challenges.

The lower urbanity means that the villages and towns are smaller and more spread out, and with it, facilities like school, shops and medical aid as well.

Most people here rely on personal transport such as cars or bike to get around, but for those who are either not willing or not able to do so, there is also the public transport network. While there are some train lines, these only connect larger towns and cities, leaving the buses to provide most coverage in the network to connect the region.

However, due to the limited availability, and the reliance on personal transport, the demand for public transport is not high enough to keep it feasible to have a larger and well covered bus network, leading to bus lines being cut from regular service. To still provide the local residents mobility option, several voluntary organisations from within the communities have chosen to drive community bus lines throughout the region. These organisations are subsidised by Provincie Noord-Holland, receive equipment, buses and technical support from the concessionaire, but are organised and driven by community members for community members.



Figure 11. A village in West-Friesland as seen from the sky (Re/Max Connect, n.d.).

2.2 Current users

During the preliminary research, a few different types of users were identified. To be able to represent these different types of users in a more general way, as well as to be able to them as a human vehicle throughout this project, five personas were developed.

Persona creation

The personas were developed based on the insights gained during the preliminary research. Initially, the users were segmented based on demographic and occupational characteristics, resulting in the basis for the personas, which were supplemented by behaviours, traits and struggles identified in the preliminary research. Finally, the needs of these personas were aligned with the needs from the 13 fundamental needs framework.

Personas

The personas represent the different types of users, of which four are travellers and one is a driver, each with their own traits, behaviours, needs and struggles. Shown here are the personas with a shortened description. For the expanded characteristics of the personas, refer to Appendix I.



Emma

Emma represents the students, who commute to school on a daily basis, but also often travel to visit their friends. They rely primarily on personal transport like their bikes for the freedom and autonomy it offers, but occasionally use public transport to get around when it is more convenient, or when circumstances leave little choice.

Femke

Femke represents the office workers who commute to the company office when they want to work on site. With more freedom to plan their journeys around their schedules, as well as more freedom in means of travel, they often weigh their options based on comfort, efficiency and potential benefits it offers.





Martin

Martin represents the manual labourers who commute to their job sites on a daily basis. Their set schedules often limit their freedom when travelling, and they value comfort and efficiency to make the transition from work to private life as smooth as possible.



Richard

Richard represents the voluntary bus drivers. While not a traditional traveller, they are still key users of the buses. As volunteers, they are driven by their desire to support and give to their own communities, often going beyond what is asked of them.

Klaas

Klaas represents the retirees who no longer have a regular commute. Unable or unwilling to rely on personal transport, instead they rely on public transport to travel around. When travelling, they value the freedom, comfort and flexibility afforded by public transport.



Personas' travel behaviour

The personas, while each representative of a different type of user, do have shared behavioural themes across each other. In figure 12, three sets of opposing behaviours are displayed in the form of axis, with the personas placed along the axis to represent their behaviour.

The horizontal axis represents the awareness of the user, whether they are aware and present in the world around them, or whether they are (mentally) removed from it.

The left vertical axis represents the involvement of the user in the decision-making process regarding their journey, and how much influence they have and exercise in the choices made.

Finally, the right vertical axis represents how much the user interacts with their surroundings, and whether they form connections or not.

By placing the different personas in this graph, they can easily be compared, and an early distinction can be made between the personas who are more aware and present during their travels (Emma, Klaas and Richard), and those who are less so during their travels (Femke and Martin).

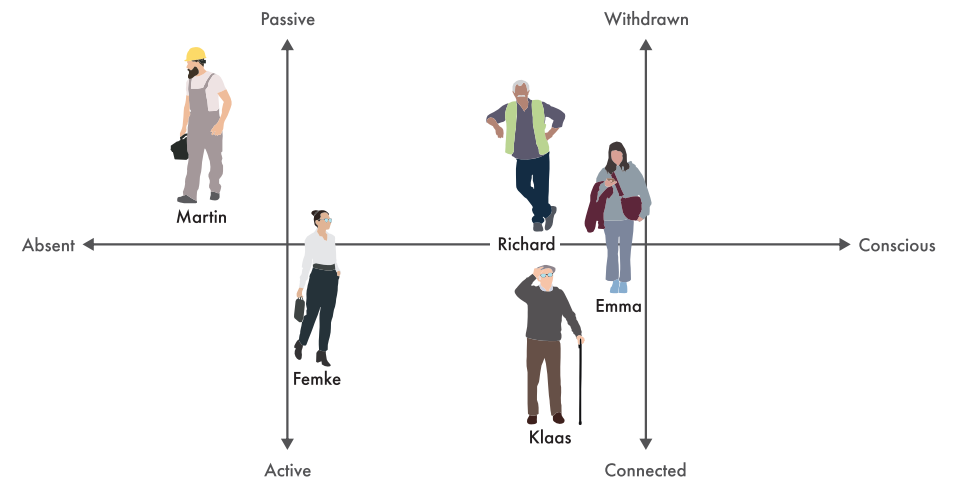


Figure 12. Personas' behaviour during travel.

2.3 Conclusions

In concluding the 2024 situation, the current context, as well as the relevant users in this context are identified.

Conclusion

While the quiet life of the 2024 Noord-Holland Noord life has its comforts, it has its equal share in challenges. One of those challenges is the accessibility of resources and facilities in these lower urbanity areas, namely for the residents and travellers who are unable to easily travel on their own.

One solution to this problem is provided by the community itself in the form of the community bus, a bus driven by voluntary community members to provide support and mobility to those who need it.

Amongst the users of these services in Noord-Holland Noord, five types of users are distinguished. Four travellers, and the voluntary bus drivers themselves. Each user has their own personal needs and struggles when travelling within Noord-Holland Noord.

Key insights

- With the lower urbanity of the region, not only are the resources and facilities spread thin, but so is the public transport network, leaving some unconnected.
- Through the community buses, the strength of the communities of Noord-Holland Noord is made visible.
- There are five types of users specified within the context of this project, four of which are travellers, while one is the driver.
- Of the five personas, there are three who are more aware and present during their travels.



3. The 2040 vision

Introduction

Now that a good understanding of the current context, the current personas and their traveller journeys is created, a vision for 2040 can be created as well. Through the use of the Vision in Product Design method (Hekkert & Van Dijk, 2016), a 'future filter' can be created which can be used to translate the current context and personas into those of the future 2040 scenario.

With a clear image of the 2040 scenario, the goal of the project is reformulated to reflect the stance towards this future, and with it a mission statement can be formulated. Finally, an interaction vision is defined to aid in designing a concept, and its interactions.

Contents

This chapter will begin with a brief explanation of the Vision in Product Design method, and highlighting of its main steps. After this, the creation of the future filter will be discussed before the mission statement, the interaction vision and the desired traveller journey will be defined.

3.1 Vision in Product Design

The Vision in Product Design method, or ViP method, is a design method developed to aid designers in designing in and designing for complex and far future visions. However, the steps in the ViP method take care to thoroughly analyse current and future developments, and seek connections between these developments to create a future vision that is rooted in current day reality.

The process

A design process utilizing the ViP process usually starts with a so-called deconstruction, wherein a current product, the way this product is used, and the context of use are all thoroughly analysed to not only gain an understanding of what this product is, but also why it is, and what its reason of being is.

Next, the future context is designed, creating clarity towards the new context of use, and the future users. This allows for a new, desired interaction to be identified and designed, from which the future product can be designed as well.

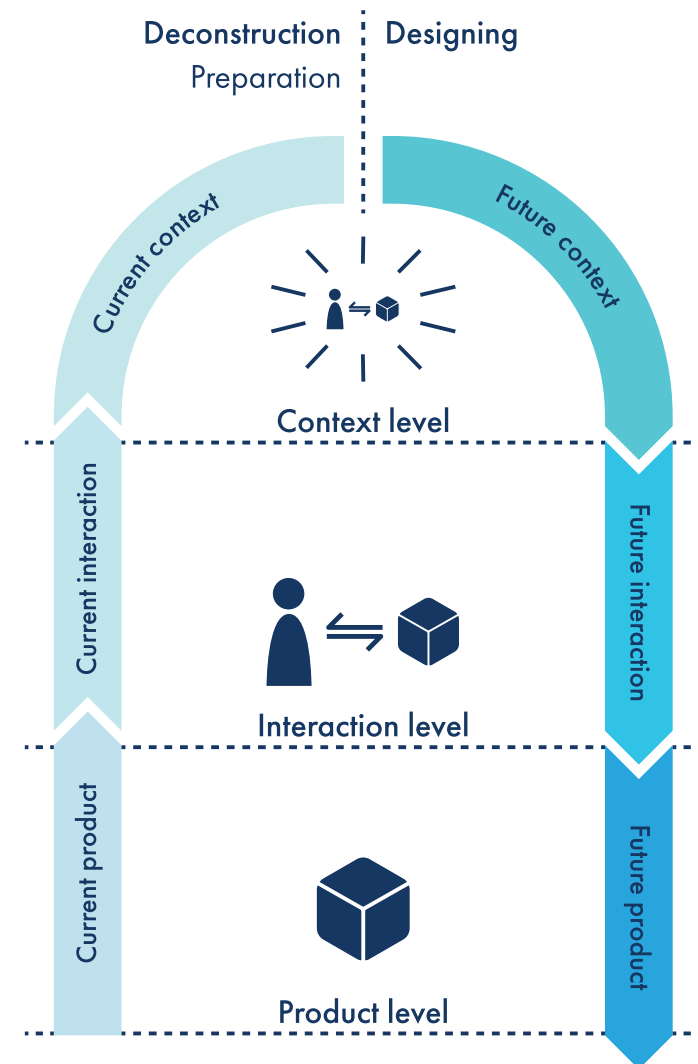


Figure 13. The ViP framework.

Designing the future

Towards designing the future context, interaction and ultimately the product, several steps will be taken. Below, these steps and their function are briefly explained.

Domain

Rather than define the target audience based on socio-economic or -demographic factors, ViP instead opts to define target audience in a more open way in the form of a domain. This helps in approaching the future users, their behaviours and experiences more openly, allowing for a greater design richness.

Factors

The identified future developments are defined as factors. In the ViP method, a large quantity of factors relevant to the established domain is collected. Care is taken to not only seek out a depth in the factors, but also a breadth in the topics covered.

Clusters

Connections are sought between the factors. While factors may easily be clustered purely on topic or type of factor, truly valuable clusters aim to connect factors of different topics to tell a story. By continuing to cluster, a clearer image of the future worldview can be created.

Mission statement

The future worldview showcases a prediction of the future context, but it also permits the designers to take a stance. Through a mission statement, they define what they aim to achieve with their design, and what impact they want it to have on this future.

Interaction vision

To translate the mission statement into a design, a vision for the interactions is defined. In this vision, an analogous situation is sought out where the same effect and experience is achieved. This allows designers to identify the qualities of the interactions and the product that should be embodied in their design.

3.2 Creating a future filter

To be able to take the project into the future, and translate the current context, personas and into a vision for the future context and profiles, a future filter must be created. This filter allows this translation to be based in reality, resulting in a plausible vision for 2040.

Domain

The first step in the creation of the future filter is narrowing the scope, and defining a domain. This allows for a broader definition of the target audience, while also providing guidance towards defining the areas of research during the factor aggregation.

In defining the domain for this project, the starting point was the problem as defined in the preliminary research section, namely the element that describes the inaccessibility towards the (public) transport. Through several iteration, the domain and its specific wording were carefully chosen to be as follows:

Experiencing the limited travel options when travelling within 2040 Noord-Holland Noord.

Experiencing

Whether the traveller wants to or not, they are experiencing the world around them. While there is a difference in how much each traveller experiences, they experience it nevertheless.

However, in experiencing the world around them, they also experience everything that is lacking in this world.

Limited options

Everything is limited in some regard, and while that is not inherently a bad thing, it becomes harmful when it hamper the experience and journey of a traveller.

Sadly, travellers run into such limitations all too often, barring them, sometimes physically, from the experiences that lie beyond.

Domain and personas

With the introduction of the domain, the personas might seem redundant as both tools can be used to define a target audience, and therefore aim to occupy the same role. However, this is not the case, as the domain and the personas will be used in conjunction to not only gain a clear idea of who the target audience is, but also gain a more detailed understanding of what their behaviours, struggles and needs are.

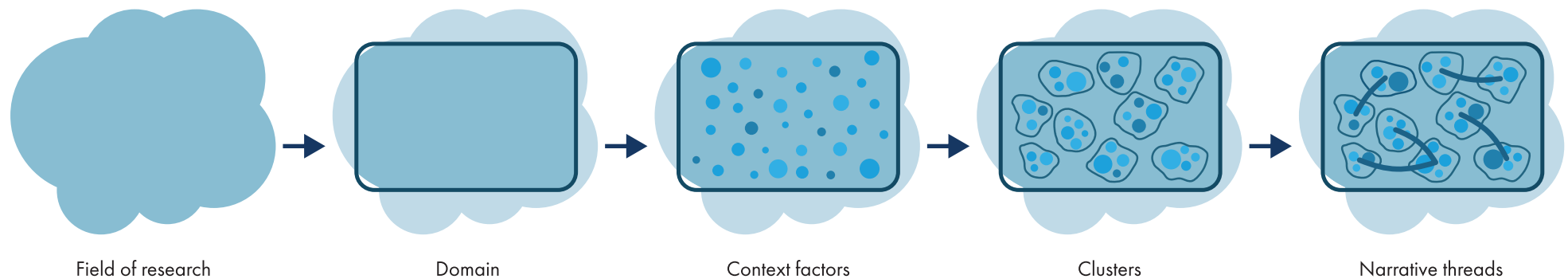


Figure 14. Process towards creating a future filter.

Factor aggregation

The basis of the future filter are the individual context factors. Each individual factor represents a trend or development that is relevant to the domain and the scope of the project.

The factors were collected through various channels, such as scientific papers, news article or discussions with peers and expert. To ensure both a good depth and breadth in the topics and information covered by the factors, the DEPEST model and the typology of factors were referred to.

The DEPEST models suggests six categories for factors, namely Demographic, Ecological, Political, Economical, Socio-cultural and Technological, while the typology of factors distinguishes whether a factor is a trend, development, state or principle.

By classifying each factor based on the DEPEST model and the typology, gaps in coverage could easily be identified and subsequently filled.

In total, 108 individual factors were identified. The full list of factors and their classifications can be found in Appendix J.

Clustering

The clustering of the factors was done in three rounds, wherein each factor was written on a Post-It (either physical or digital), and connective stories were sought between the factors. This process, done both individually and with peers, resulted in 32 unique clusters. In a similar fashion, these 32 clusters were then clustered once more to identify six underlying clusters, here named narrative threads. The full clustering of factors can be found in Appendix K.

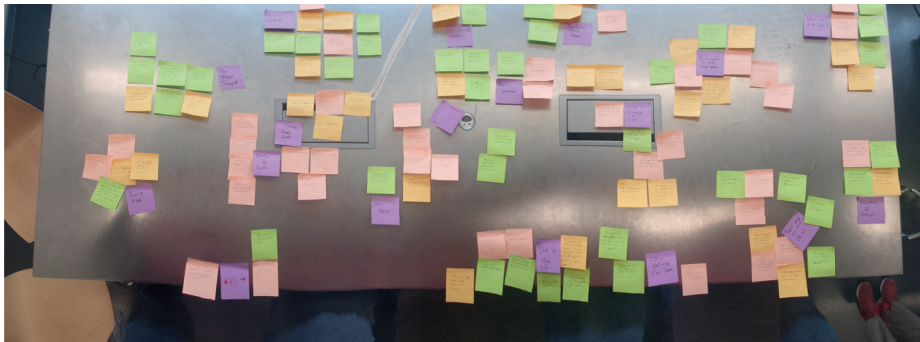


Figure 15. Physical clustering of context factors.

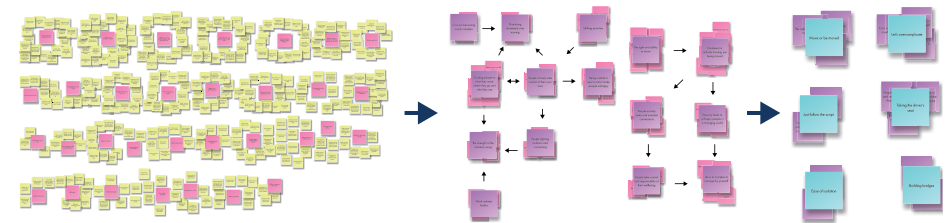


Figure 16. Progressive clustering of context factors to clusters, and from clusters towards narrative threads.

Narrative threads

The six narrative threads can be used to tell the stories of how the world, the people in it and their behaviours within the chosen domain might change towards the future. These form the basis for the future filter, allowing the current context and personas to be translated into their future counterparts.

Just follow the script

These days life is easy. You hardly have to do anything yourself. The algorithms know what you want, where you go, who you are, and they predict what you'll want to do next. It practically knows you better than you know yourself. All you have to do is go along with it.

image source: Andrew Billington Photography

Take the driver's seat

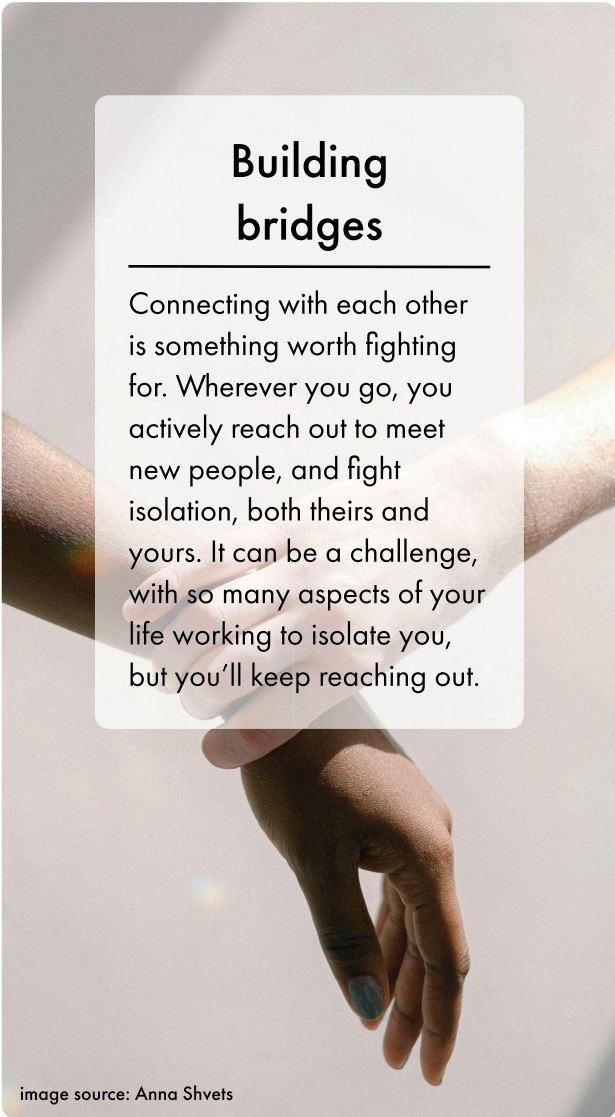
These days life is challenging. You want to take control over your own life. You want to be an individual, with your own identity and life, rather than a serialized data point. You want to exert your control and make an impact on your own life, as well as the world around you.

image source: Cottonbro Studio

Ease of isolation

It's easy and comfortable to stay in your own bubble. The cities are filled with young, likeminded people, while the rest has fled. Wherever you are, if you go about your life smartly you'll only meet people like yourself, with needs, opinions and lives just like yours.

image source: Paul Theodor Oja



Building bridges

Connecting with each other is something worth fighting for. Wherever you go, you actively reach out to meet new people, and fight isolation, both theirs and yours. It can be a challenge, with so many aspects of your life working to isolate you, but you'll keep reaching out.

image source: Anna Shvets



A world of overcomplications

Too many things are getting too complex. Whether it is your products, your life or the world itself, it's getting overbearing. Sometimes you just feel like nodding and playing along, as you don't have the energy to concern yourself with everything anymore.

image source: Primadara



Move or be moved

These days moving around isn't as clear as it once was. Will you have to move yourself, or will someone do that for you? Will you be moved by a person, or will you be moved by robots? Who these days is even allowed, or for that fact, able to move you?

image source: Anna Shvets

3.3 Future situation

Through the use of the future filter, the context and the personas are translated. However, in doing so, it also becomes clear that the expected future might not align with the visions of Provincie Noord-Holland, or with the values of me as a designer. Thus, besides the expected future, a desired future is also defined.

Future context

Through the use of the future filter, a future is identified where the current dynamics maintain their presence, and where the people in that future take on an increasingly passive role. In this future, people simply go along with what is told to them, either by other people, or algorithms like AI assistants. People act and move according to optimised routes and schedules, supported by ever evolving and improving technology, leading to an optimized, efficient and streamlined society. However, while this overoptimization leads to convenience and comfort, it leaves little room for human interactions, leading to people becoming less involved and isolated, even amongst crowds.

This expected future is also in line with a scenario study on smart mobility by Provincie Noord-Holland (Provincie Noord-Holland, De Ruijter Strategie, 2024), and is characterised by individual compliance to the changes and instructions of the system.

While this future context is likely to occur, it is not a desirable one, as a society that is isolated, withdrawn and passive does not align with the vision of Provincie Noord-Holland towards a healthy, vibrant, vital and socially-connected Noord-Holland Noord.

Thus a second future is identified, one that still adheres to the same future filter, but that presents a more desirable outcome. In this desired future, people are more protective of their autonomy, choosing to take a more social and active disposition in their lives. Here, people are still supported by the convenience and efficiency offered by the improving technology, yet not at the cost of their own autonomy.

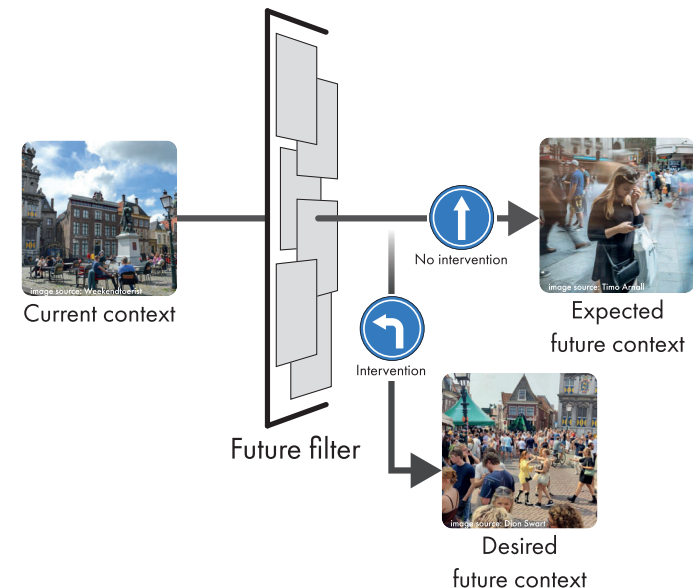


Figure 17. Translation from current to future contexts.

Future profiles

Like with the context, the future filter can also be used to define how the specific personas would change, aligning them to the future contexts that were defined earlier.

This changes the current personas into future profiles. These profiles still aim to represent a type of demographic, but are no longer bound to specific identities to accommodate the more speculative nature of these profiles. As with the personas, shown here are the profiles with a shortened description. For the expanded characteristics of the profiles, both expected and desired, refer to Appendix L.

Like with the contexts, the personas are expected to develop into the future profiles in a specific direction, going along with what is told to them, and generally becoming more isolated, less conscious and less involved of the world around them. They'll rely more on support from external sources, be they human or otherwise, and strongly value the convenience that comes with it.

A second set of future profiles is then also defined based on the desired future, where the personas instead develop in a way that prevents the loss of their autonomy and their active disposition, with behaviours and needs that resist the changes leading to the isolation and passivity.

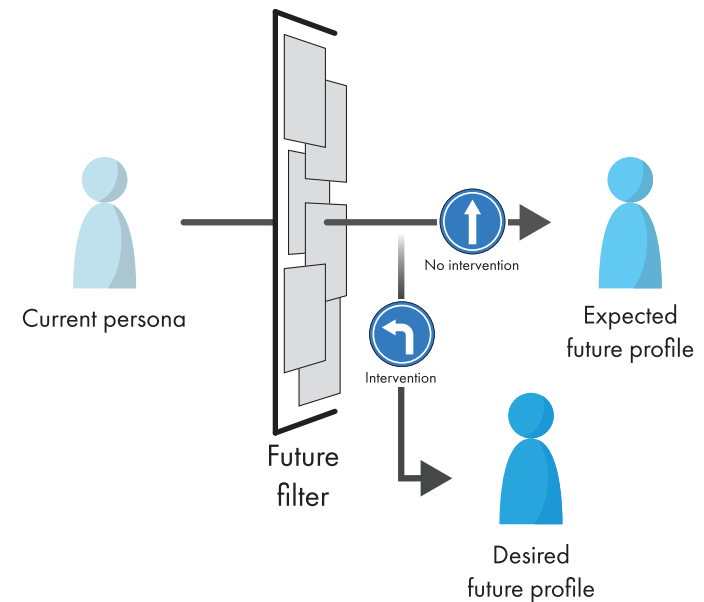


Figure 18. Translation from current persona to future profiles.



Future students

The change from current day Emma towards the expected future student is predominantly driven by convenience. However, while letting algorithms and others decide for them how to live is immensely convenient, giving away this autonomy leaves them with a feeling of powerlessness. The desired student on the other hand strives to maintain this autonomy, going out of their way and fighting to remain in control.



Future laborers

The change from current day Martin to the expected future labourer is in large part familiar to that of the worker, with the labourers simply adhering to whatever they are told, and doing exactly as instructed. They value convenience and efficiency to make their job as easy as possible. The desired labourer more actively concern themselves with managing their work, and with it, their lives.

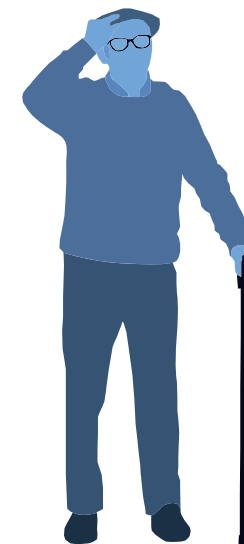
Future workers

Transitioning from current day Femke, the expected future worker shifts their focus more towards working, letting it influence most parts of their lives. In this, they desire efficiency and performance in their work, caring little for most things outside of that scope. The desired worker sets clear boundaries, consciously deciding where and how to dedicate their time.



Future retirees

In transitioning from current day Klaas towards the expected future retiree, the ever increasing complexity of the world plays a large role. Unable to keep up with this complexity, they opt to withdraw themselves, leaving their technology to guide them. The desired retiree chooses a different path, aware that they might not understand everything around them and accepting it. Their focus lies in maintaining control over their own life and wellbeing.





Future drivers

The change from the current day Richards towards the expected future driver is driven by powerlessness. While still feeling obliged to help their community, their motivation has shifted from wanting to give back to simply fulfilling a role that needs to be played. Contrary, while the desired drives still fulfil the same role, they go beyond what is required, wanting to help their community beyond only mobility.

Shift in travel behaviour

Similar to before, the future profiles can be placed a graph to not only be compared the behaviours of the other profiles, but this time also against the original personas.

As established in the domain, the scope of the project revolves more around experiencing the journey, and the level of consciousness therein, and thus the profiles displayed here will be narrowed down to the three personas (Emma, Klaas and Richard) which were originally more conscious and aware.

Unsurprisingly, the expected future profiles shift further away from being conscious, and more towards absent, passive and less involved behaviour, while the desired profiles shift towards being connected and conscious.

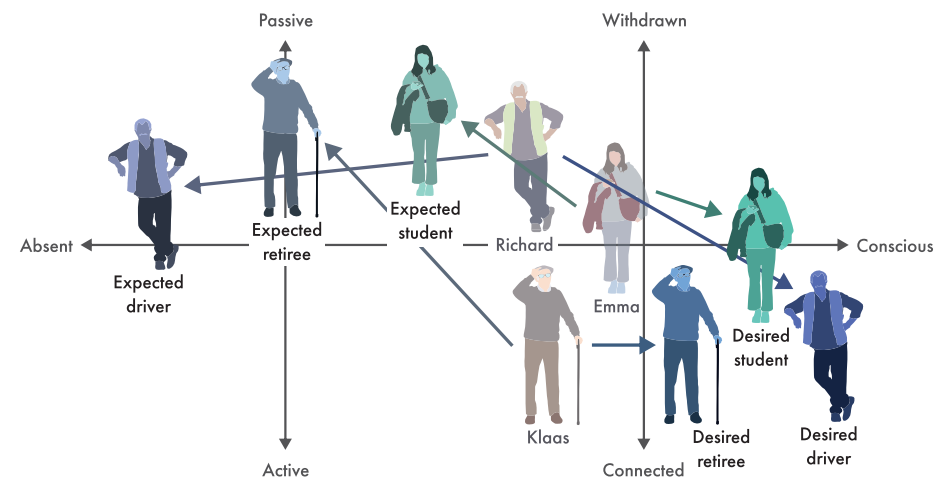


Figure 19. Expected and desired shift in personas' behaviour during travel.

Most interesting here is the behavioural shift for Richard towards the future drivers. When the autonomy of the driver diminishes, so too does their ability to help their communities, resulting in them feeling powerless, and becoming absent. However, should this autonomy be maintained, and the drivers be able to play a bigger role, then they become much more conscious and connected within and to their communities, and take on the role of a connecting party.

3.4 Mission and vision

With a clearer image of the future context and travellers in mind, the goal of the project is expanded slightly to accommodate the need for an intervention to steer away from the expected future, and towards the desired future.

The expanded goal of the project is thus to provide a connection between home and the further public transport network in a way that stimulates traveller wellbeing, and steers their behaviour towards the desired behaviour.

Mission statement

The project goal then allows for the formulation of a mission statement that provides guidance in the designing process. The mission statement is comprised of the earlier established domain to clarify the target audience, followed by the mission explaining and how we intend to fulfil the goal.

In the domain of experiencing the limited travel options when travelling within 2040 Noord-Holland Noord, we want to invite the travellers to reach out and connect with the people and the world around them.

Invite

In a future where it is easy for people to just follow the instructions given, we should not be yet another voice giving instructions. Instead, we should only extend a hand and allow the recipient to accept or deny this invitation on their own terms.

Reach out and connect

Once the invitation is extended, we want people to extend their own hand in return, reaching out to grasp the invitation. In this they breach their own isolation, and an opportunity is given for them to build a new connection.

The people and the world around them

We want the people who reach out to build new connections to do so not only with other people in their direct vicinity, but also the people who farther away, and the community that exists around them both.

Interaction vision

Where the mission statement defines the effect the design should achieve, an interaction vision provides guidance in how interactions with the design should feel, and how they should be experienced.

Defining how the experience should feel in an unknown situation is challenging, so an analogy is used. Here, a different situation is sought, one that is in a different domain, but provides similar experience. The identified qualities and the characteristic of the analogous situation are then applied to the interactions with new design, helping further define it.

The analogy used to identify the qualities and the characteristics is chosen to be as follows:

Like visiting good friends for a coffee.

Good friends

You aren't just going for a coffee with strangers, but instead with your good friends. You know these people very well, and have a strong bond of mutual trust and friendship with them. Your contact feels **familiar**, **warm**, **trusted** and most of all, **comes naturally**.

Mi casa es tu casa

Good friends often tell you that their door is always open to you. You know that when you visit, whether planned or at random, they'll happily welcome you inside. While it is their home, still you feel at home yourself. The **warm** and **trusted** nature of your contact reflected in the space, along with the **homely** and **cosy** atmosphere of the home itself.

Coming over for coffee

While the physical activity might be to drink coffee, the true reason you visit is to share that moment with your good friends. The coffee is just a means to that end, not the highlight itself. Similarly, there are many other element in play that while important, are only there to support the activity of sharing a moment with good friends. These elements, like the coffee, the inquiring whether your friends are at home and the arriving at their place all fall to the background, virtually invisible to make the overall experience **spontaneous**, **approachable** and **free form**.

The analogy in context

Finally, the elements of the analogy can be related back to those in the actual context of public transport. In this, the good friends represent the bus drivers, their homes represent the buses, and additional elements represent the supporting network surrounding the buses.

However, this analogy is not exclusively linked to the buses and bus drivers, and can also be taken in a more general sense.



Figure 20. Interaction vision.

User journey

By analysing the analogous journey of visiting good friends for coffee, the user journey of a traveller in 2040 travelling by public transport can be explored as well.

Here, the form and details of the intervention are intentionally left vague, both to retain the focus on the interactions, and allow for more freedom in the following ideation phase.

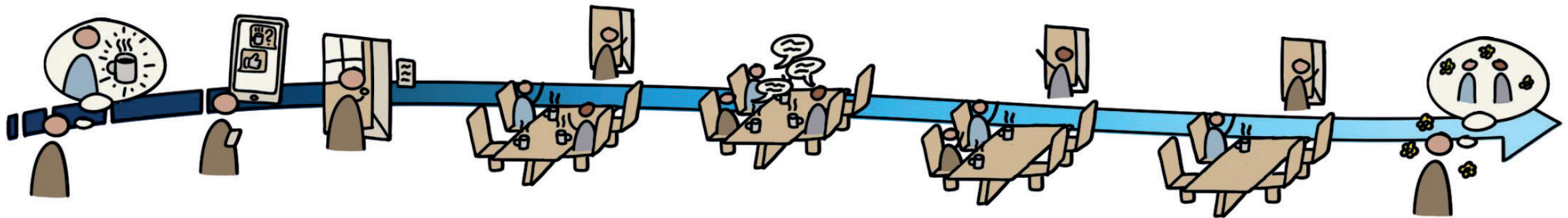


Figure 21. User journey in the analogy “visiting good friends for coffee”.

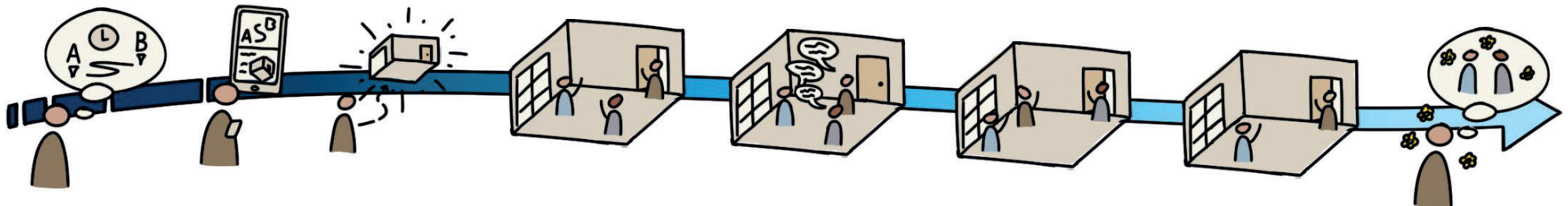


Figure 22. User journey in the envisioned intervention.

3.5 Conclusions

To conclude the 2040 vision, the aspects that will provide guidance during the design process will be summarized.

Conclusion

Through the use of the constructed future filter, an expected future is identified where the world turns more socially isolated. People move to the bigger cities, leaving the non-urban areas even more empty, and technology rapidly grows to support everyone. People value this support, and the comfort it gives enough to trade in their autonomy.

We want to resist this change, and instead envision a future where people are more active and conscious in their lives, both physically and socially. To achieve this future, we want to invite people to reach out and connect to the people and the world around them.

To aid this process, we will design an intervention in the public transport space, where interacting with it feels like visiting good friends for coffee. In this intervention, the bus drivers could play a pivotal role as the connecting party.

Key insights

- An intervention is needed to steer away from the expected future, and towards the future that fits with the vision and values of Provincie Noord-Holland and me as designer.
- In this future, we want to invite travellers to reach out and connect to the people and the world around them.
- The future bus drivers could take on a more central and important role within their communities.
- The designed intervention, and the interaction with it, should feel like visiting good friends for coffee.
- The intervention could be expanded beyond the scope of purely community buses.



4. The 2040 concept

Introduction

With the goal of the project, mission statement and the interaction vision clearly defined, the design of a concept for 2040 could finally begin to take shape. While ideation is a process that spans the entirety of a project, here the developed ideas will be converged and iterated into the 2040 concept.

Then, the 2040 concept and as its features and elements will be defined and detailed, as well as integration roadmap is proposed, before the concept will be validated.

Contents

In this chapter, the ideation process throughout this project will be explored, after which the steps from ideation towards the 2040 concept, as well as the 2040 concept itself will be explained, and a integration roadmap proposed.

Finally, the validation of the 2040 concept will be discussed.

4.1 Ideation

To build a larger inventory of ideas, ideation was done at various stages throughout the project, both actively and passively. While most of the ideation materials were captured on paper, some were only thought or spoken of, and have since been lost. The materials can be found in Appendix M.

Brainstorming

To facilitate the ideation, and to attempt to prevent the inevitable tunnel vision that came from working on this project and context for an extended period, brainstorming was used in different sessions to rapidly generate ideas without applying constraints. These sessions were either alone, or with student peers.

Prompts

To help guide the various brainstorms, prompts were used. These prompts were carefully chosen to not introduce too many constraints into the ideation process, but also provide enough guidance to result in useful generated materials.

Initially, these prompts would be quite open and vague, such as “how would you make a bus cozy?” As the project progressed, the prompts could be narrower and more refined, leading to new prompts such “how would you make a space feel like home?”

Persona based ideation

Brainstorms were also done based on the personas and profiles. Here, ideas were generated purely to provide solutions to the struggles that the personas and profiles encountered, or to fulfil their identified fundamental needs.

Again, initially this ideation was done based on all personas and profiles, while later on this was focussed towards the specific profiles with higher focus.

Associative ideation

Besides the generation of new ideas based on prompts or other external factors, ideas were also generated on other ideas through associations. Through this, ideas could evolve further, or new paths could be explored.

Other activities

Lastly, some side activities were done which did not directly generate ideas, but would aid in the generation of ideas, such as attending the Dutch Design Week in Eindhoven, or the passive discussions of the project with peers.

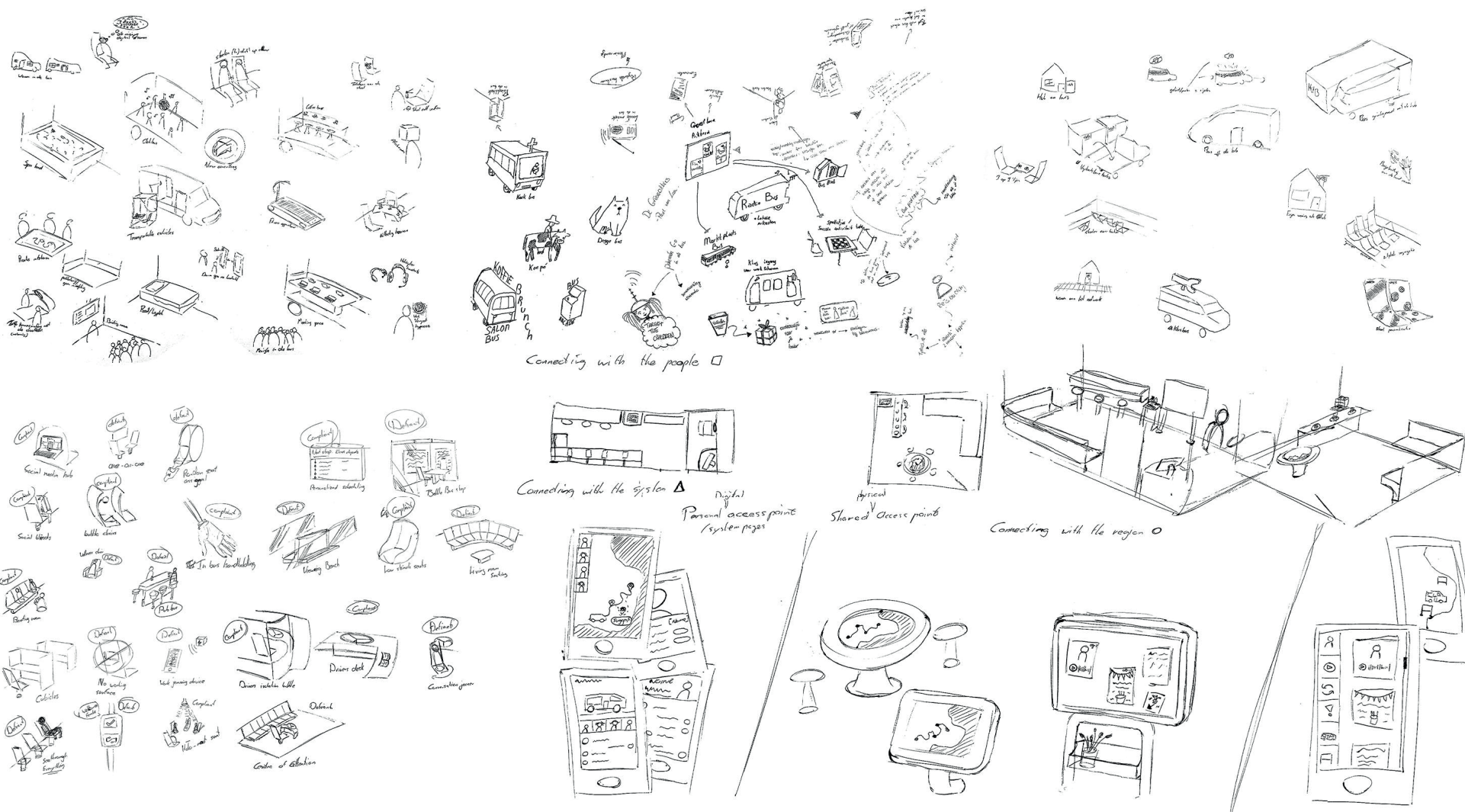


Figure 23. Select ideation materials.

From product to system

During the analysis of the analogy, as well as the ideation itself, a realization about the intervention arose. In order to fulfil the mission statement, and by extension the goal of this project, the intervention should not only be a redesign for a single vehicle, but should instead be a redesign of the bigger system as well.

Thus, going forward with ideation, and towards developing key ideas, this perspective was taken into account.

Developing ideas

With the scope having shifted from a product to the larger system, the design space has also increased in complexity. Therefore, rather than only develop towards a singular product concept, the various elements of the system, as well as the system itself, were identified and defined.

This is done to create clarity both on the workings and the overarching role of the system, as well as that of the smaller elements which make up the system.

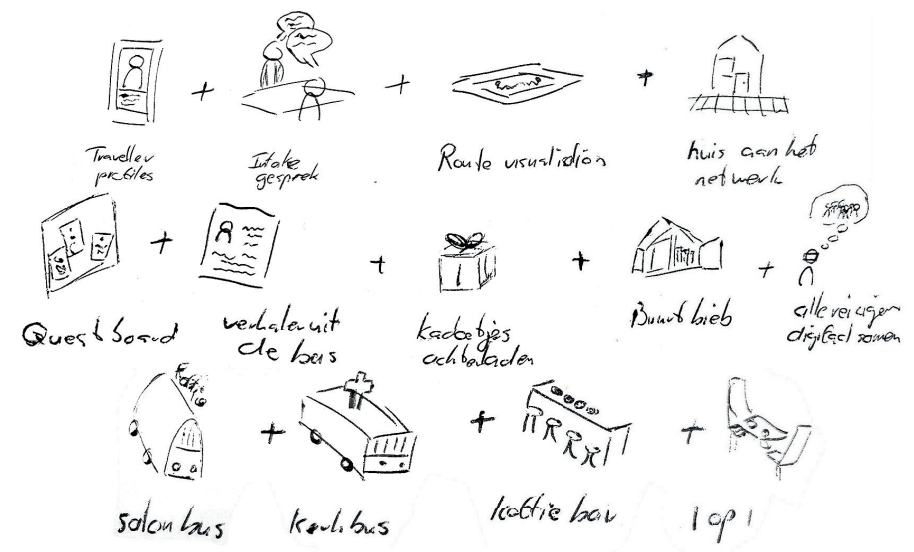


Figure 24. Examples of the process of combining ideas to create more complex elements.

Key themes

In the development of ideas, three key themes emerged. The first theme entails the humans of the system. As a system that aims to support people to forge new connections, it must take care to place the control in the hands of the people, and place them in the centre of the system.

The second theme regards the spaces of the system. The forging of the connections will not take place in a vacuum, but instead in existing or new spaces. Therefore, these spaces will need to be able to support the forging of these new connections.

The third theme involves the supporting network of the system. There are many processes and elements that take place behind the scenes in this system. These elements should work to support the people in the forging of new connections, but do so silently as to not obstruct or interfere.

Iteration

Through iteration and convergence, the ideas are developed into the final form of the concept and system. This is done to not only ensure clarity on the system, but also to ensure that the elements of the system are aligned to the key themes, as well as a unified vision.

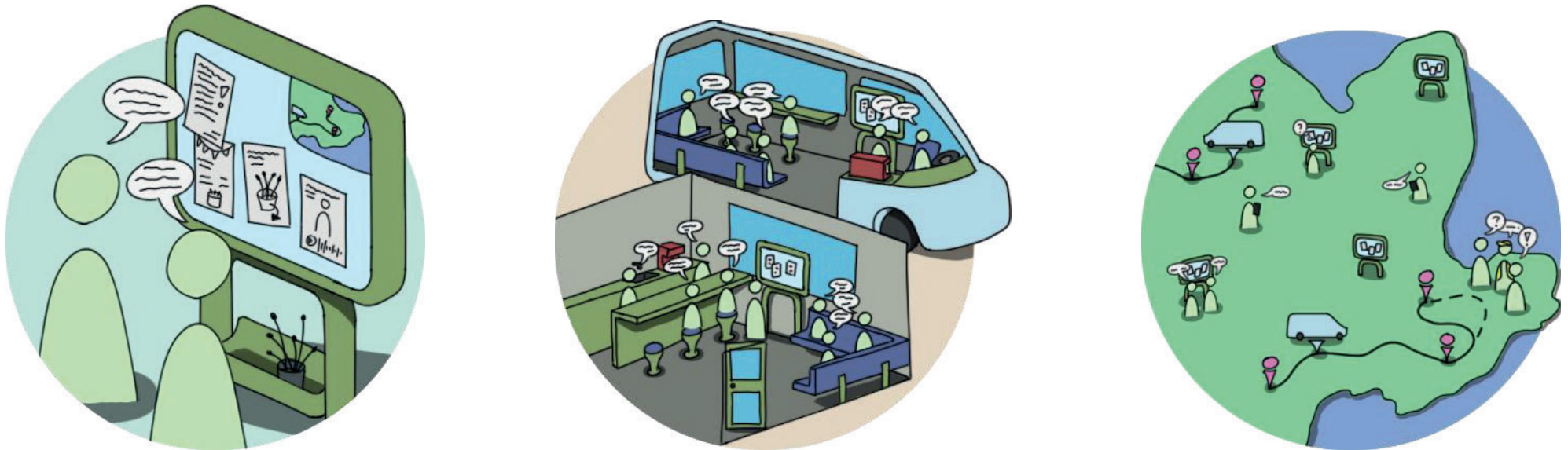


Figure 25. Three key themes of the humans, the spaces and the network.

4.2 Sociaal-waardig OV

Iterating and integrating the key ideas results in the final 2040 concept: Sociaal-waardig OV, or SOV. A play on the term HOV (Dutch abbreviation for High-grade Public Transport), Sociaal-waardig OV focusses on the creation of a high quality social experience over that of a journey focussed on speed and comfort.

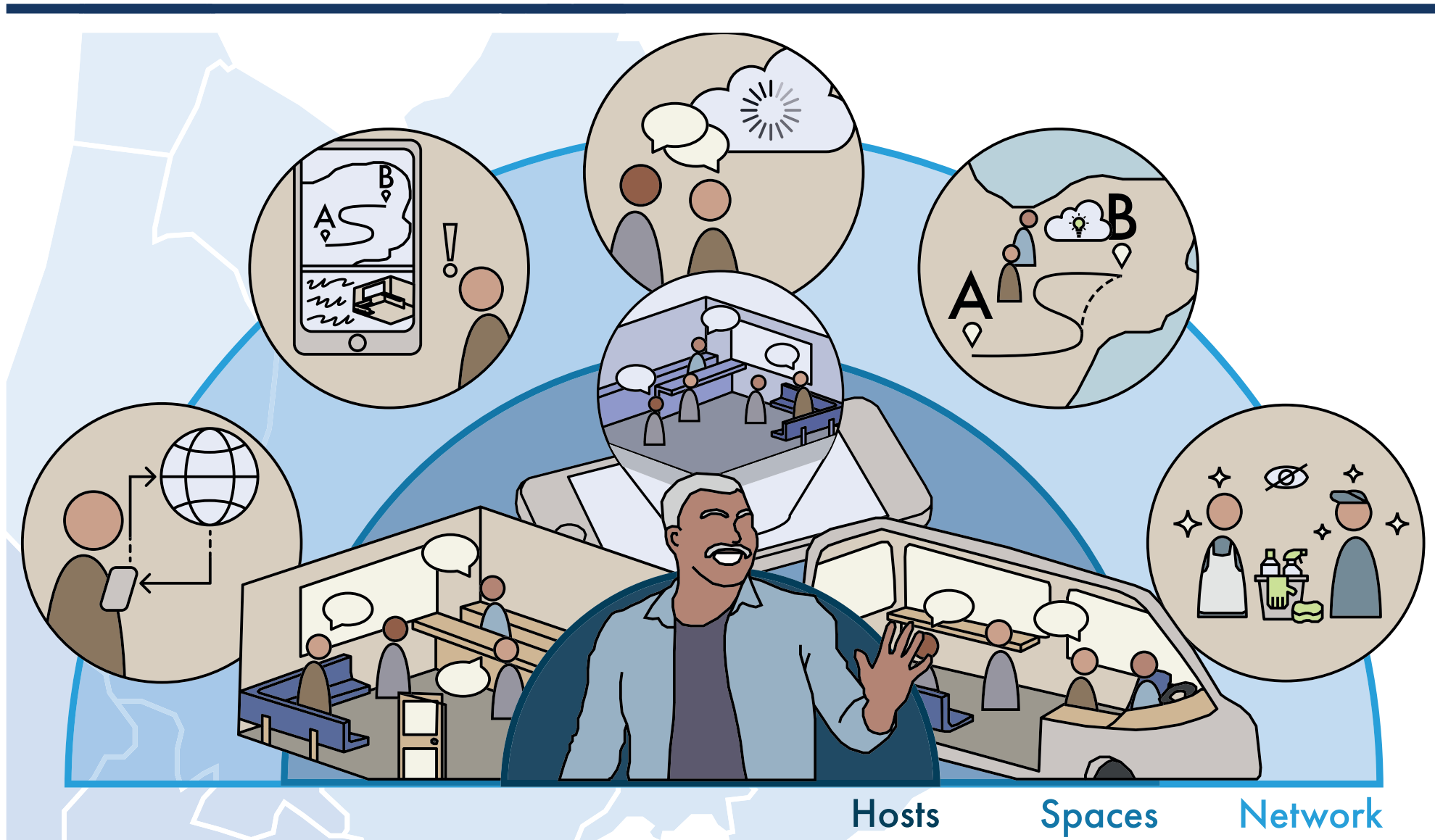
A redesigned system

The redesign from current day public transport to Sociaal-waardig OV aims to establish public transport as something more than means of moving people from one place to another, and instead something that fosters connections, builds communities and enriches daily lives. The redesigned system moves beyond traditional frameworks to prioritize the human experience, and is centred around three core elements: empowered hosts, inviting spaces and a seamless supporting network.

At the core of this system stand the hosts, individuals whose roles go beyond driving to create a welcoming and engaging environment for all. As approachable figures from the community, they ensure that the journey feels personal and connected.

Supporting the hosts are spaces to connect, dynamic buses, static hubs, and digital platforms, each crafted to evoke a sense of warmth and inclusivity. These spaces encourage meaningful interactions, whether during travel or within the broader community.

Tying everything together is a supporting network of tools and technologies that quietly operates in the background. This network enhances convenience and efficiency through automation while providing the hosts and spaces with the resources they need to deliver a seamless, enjoyable experience.



From drivers to hosts



To transitions from the drivers to the hosts that stand at the centre of the system, the roles of these individuals will need to change and shift away from purely functional aspects, and instead focus more on their social duties, not only within their buses, but in their communities as well.

Within their new roles as hosts, their goal is to welcome and invite guests, and to create and maintain a pleasant and stimulating social atmosphere in the spaces they steward, not only with their guests directly, but also amongst their guests.

In this, the hosts position themselves as the always approachable and trusted friends from the community.

Spaces to connect



To support the hosts in their social duties, the spaces they steward are all designed to evoke the same warm, cosy and homely experience, and encourage meaningful interactions. These space can vary greatly, but can be categorized as either static, dynamic, or digital.

Static spaces are physical locations, like hubs, that enhance the experience of the guests while they wait for the next step in their journey. While these spaces have the potential to become prominent social spaces for the community, they face a challenge in regards to their necessity and demand for them. New spaces can be created, but existing spaces can also be adapted to fulfil this role.

Dynamic spaces are the local buses that physically transport guests. These spaces are limited in size, and the hosts, who also serve as drivers, must split their focus between social engagement and driving. However, as autonomous driving technology advances, hosts will be able to concentrate more on their social duties.

Digital spaces include online chatrooms, message groups, and community pages that connect remote users with other community members. The main challenge here is ensuring that these digital interactions feel as genuine and meaningful as those in physical spaces.

A supporting network



The final layer of support comes from behind the scenes. A network of supporting casts and technologies that aid the hosts and spaces in delivering the pleasant and socially stimulating journey, allowing the hosts and their guests to focus on having meaningful interaction. To this end, this network and its components will nearly go unnoticed, feeling unobtrusive, convenient and intuitive.

The network allows its users to remotely gain access to its functional and social features, as well as gain insight into and view information on the system.

It autonomously processing payments, check-ins and transfers in the background, as well as optimizing the routes to create a more efficient coverage of the region, fitting to the needs of the passengers.

Finally, the system and its components are silently maintained and cleaned to grant the users a carefree and pleasant experience.

4.3 Integration roadmap

To give an overview of the steps that could be taken to work toward the integration of the concept, a roadmap is given. This roadmap is divided into three time frames, or horizons, and provides guidance to the general steps that need to be taken by relevant parties.

Horizons

The roadmap is divided in three horizons: current concession, next concession and future concession.

Current concession (2025 - 2028)

In horizon 1, and the current concession, the goal is to lay the groundwork, and prime the current system for the upcoming bigger changes.

Features that could be implemented without significant disruption to the system should be implemented, and the people, both drivers and travellers should be primed for changes in the usual social interactions.

Next concession (2028 - 2038)

With horizon 2, the focus should be put on implementing the disruptive changes. With the new concession, the opportunity arises to introduce significant change.

A flexible operation of the bus lines should be explored to suit the traveller's demand, and the introduction of (partially) autonomous driving should be implemented as well. Hubs should also be introduced to the system, either newly build, or by integrating existing community spaces (such as community centres or libraries) into the system.

These changes could be implemented in select bus lines to start, but should gradually expand to be implemented across the entire system.

Passengers should be prepared to let the system take mundane tasks off of their hands, and instead be steered towards social activities.

Future concession (2038 - 2048)

By the third horizon, the concept as designed should effectively have been completely implemented. People no longer need to be concerned with operational tasks, and can instead fully focus on their social interactions.

At this point, the expansion of the system could be explored, integrating the local public transport system into larger, national systems. The possible use of non-human agents (such as AI) could be explored as well within the context of the system.

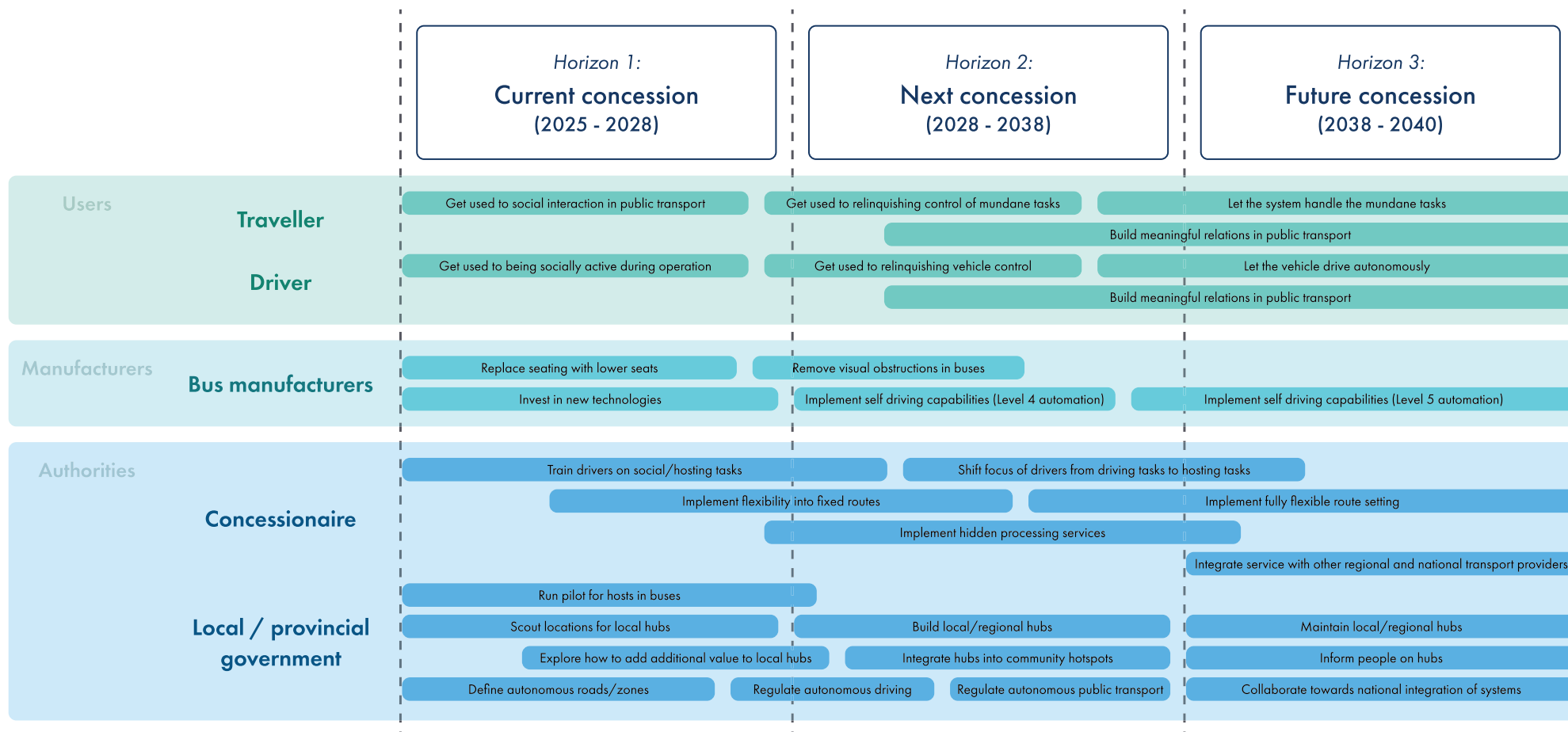


Figure 26. Sociaal-waardig OV roadmap.

4.4 Concept validation

To evaluate whether the concept aligned with the goals of the project, mission statement and the interaction vision, as well as to determine the suitability of the concept, a validation was performed.

Goal

The goal of the validations was to assess whether the concept for the redesigned public transport system aligned with the project goal. It also aimed to gain insight into the desirability and viability of the concept, both from the perspective of the users, as from that of Provincie Noord-Holland.

However, as the concept for a redesigned public transport system is exactly that, a concept, the goal of the validation was not to validate this specific expression of the system, but rather the effect and impact it could have on the broader community and public transport.

Finally, the goal of the validation was also to gain insight to be used towards making slight adjustments to the concept and the iteration of the integration roadmap, as well as aid in the formulation of design guidelines and recommendations.

Plan

Due to the limitations coming from being a concept for a 2040 public transport system, the decision was made to validate the concept through discussion with experts rather than through user testing.

This discussion took place with three experts from the public transport team from Provincie Noord-Holland, and took about one hour. The choice was actively made to have the discussion with all three experts at once rather than individually to stimulate an open, more free-form discussion which allowed for a greater richness of topics discussed.

Findings

The discussion with the experts provide valuable insights on the concept, highlighting key areas for success. In this discussion, a strong consensus emerged around the role of the drivers, with the experts agreeing that a shift towards the role of a hosts could enhance the passenger experience in and around public transport. The experts also noted the value of using hubs as community spaces where people can connect and support one another. They noted how this aligned with the larger vision of Provincie Noord-Holland as well.

The experts did emphasize the importance of accessibility to the system, amongst whom the elderly, to ensure usability and prevent unintended isolation for all demographics. Additionally, the experts noted the conflict between efficiency and social value. While placing hubs at village edges improves the operational flow, central locations foster social value.

The experts also highlighted affordability and staffing challenges as concerns, and while the reliance on the communities, similar to the community buses, could present a solution, they noted that the viability should be evaluated thoroughly. In this, a solution could be to conduct pilots with select community bus lines to assess both the viability and the user reception before scaling. In this, they noted the necessity of a implementation plan.

"I am convinced that there are opportunities [in the social vision on public transport]."
- Expert 1

"I would much rather have a community centre than a hub at the edge of town."
- Expert 3

"While there are many challenges, I think this is definitely onto something here."
- Expert 2

4.5 Conclusions

To conclude the 2040 concept, the concept and integration roadmap as well as the points that will aid in the formulation of the final conclusions and recommendation are briefly summarized.

Conclusion

Through different methods of ideations, as well as several rounds of convergence and iteration, a concept for a 2040 public transport system is created.

This concept, Social-waardig OV, envisions public transport as something more than means to transport people from A to B, and instead as an opportunity to create new connections. To achieve this goal, it empowers the drivers to take on the roles of hosts instead, tasking them with creating a warm and socially stimulating environment. To support these hosts, the system provides various spaces for these hosts to steward, offering this social space for every step in the journey. Finally, the system supports the hosts through a large supporting cast, performing many of the mandatory tasks on the background, leaving the focus on the social experience.

Through an integration roadmap, guidance is given towards the steps required to implement the concept system, for the users, the manufacturers and the authorities over the course of the current and the next concession. Lastly, it also proposes steps to take during the future concession.

Key insights

- The concept, Social-waardig OV, places the social experience above efficiency and comfort of public transport.
- It places the drivers at the heart of the system, elevating their roles to that of hosts.
- The hosts steward three types of spaces, dynamic, static and digital, providing the same socially stimulating environment across all.
- Supporting the hosts is a network handling the mundane tasks, like processing payment and route setting, on the background, allowing the hosts to focus on their social tasks.
- To implement the system, steps will need to be taken not only by Provincie Noord-Holland, but also by the users, the manufacturers and the concessionaire.

5. Concluding

Introduction

With the 2040 concept defined and validated, and a roadmap for its implementation proposed, the final step is to give guidance towards implementing the core ideas of this project into other design processes in the form of design guidelines, as well as give recommendations for the aspects of this project that could be researched or tested further.

Finally, a personal reflection on this project, and doing the Masters Graduation Project as a whole, is given.

Contents

This chapter will first provide design guidelines and recommendations, before a final, personal reflection will finish up this chapter, and this thesis as a whole.

5.1 Design guidelines

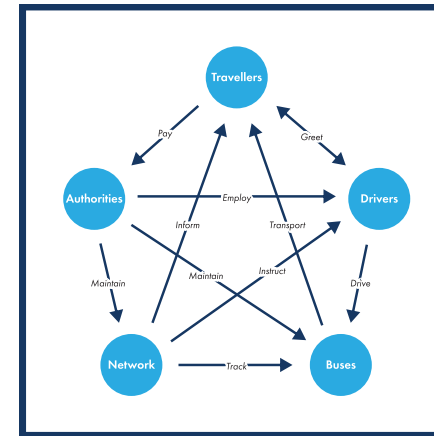
The system presented in the concept is the final result of the research and design steps taken within this specific project, and is therefore tailored to the specific context of 2040 non-urban Noord-Holland Noord.

To be able to apply the knowledge, conclusions and design philosophies found within this project to other contexts and projects, five design guidelines are formulated. These guidelines provide guidance towards designing a public transport system aimed at stimulating traveller wellbeing through social activity.

Elevate the role of the driver

Reimagine the role of the drivers, making them more than people who operate the vehicles. Instead, let them take on the more social and central role in the system, allowing them to be hosts to the people who come to their vehicles. Play in on the existing communities, and allow the people from these communities provide more meaning for their communities.

Current situation



Envisioned future situation

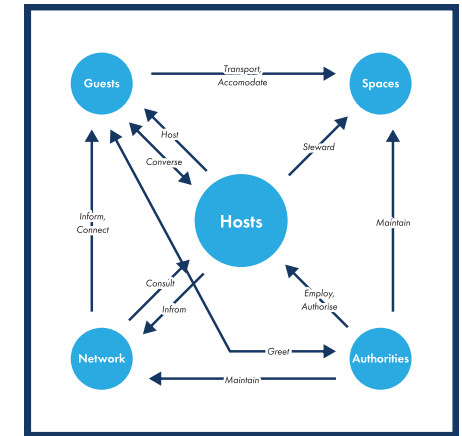


Figure 27. Relation map in the current and envisioned future situation.

Enhance the on-board experience

Reimagine the spaces of the system to be more than a waiting space. Offer people who come there comfort, warmth and a place to connect. Expand the view on what these spaces are, not just the buses, or hubs, but every space, physically or otherwise, where people interact with the system. Make time spend in this system not wasted time, but worth it.

Enhance the pre- and post-board experience

Allow people to seamlessly access the spaces, and through it the system, as well as information regarding the system. Remove obstructions where possible, lowering the threshold when removal is not an option, allowing people to focus on the experience itself, rather than accessing it.

Integrate the pre-, the on- and the post-board experience to create a unified experience for the broader journey

Tie all parts of the system together. Let the separate facets of the system seamlessly flow into each other, and align all facets to give people a single, unified experience throughout their entire interaction.

Reimagine the role of public transport authorities to facilitate mental wellbeing in public transport

View people as more than something that needs to be transport, and instead view them as someone to take care of. When they are interacting with, and part of the system, take responsibility over them, and prioritize their wellbeing.

5.2 Recommendations

Testing

This project was subject to resource and time limitation. Some of the areas impacted by this limitation were the testing opportunities.

Expanding sample size

In general, the sample sizes of the tests conducted throughout this project were limited. Therefore, it is strongly recommended to perform the tests with more participants to find potentially missed insights, and achieve a higher statistical significance.

Validating with users

Regrettably, time constraints near the end of the project made it not possible to validate the concept with users, or user representatives. As a user centered design, it is highly recommended to perform validation tests with these users to ensure the desirability of the concept from the users perspective.

Pilot tests

Of course, an invaluable method of testing the effectiveness of a concept is through pilot testing. For this, the already existing community lines are highly suitable due to lower operational and material costs, their established positions within their communities, and their position in the larger system.

Concept development

There are areas that could be explored should the concept be developed further.

Explore the role of the human

As the concept progresses towards the future, human operators could become obsolete within the system. Therefore it would be valuable to assess the necessity of human operators, whether or not the system would work without them, and if so, what else could and should fulfil their previous roles.

Further future situation

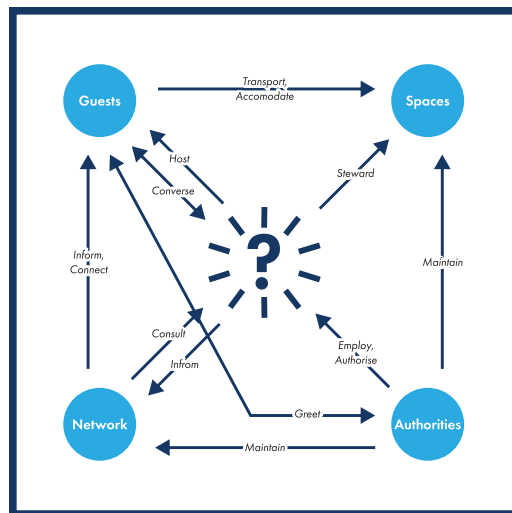


Figure 28. Relation map in the further future situation.

Designing interiors

With the importance of the interior design for the atmosphere in a space, it is highly recommended to critically assess the interior design in currently existing spaces, as well as that of the future spaces to create a socially stimulating environment. For this, collaborations with interior design agencies in combination with vehicle manufacturers should be explored as well.

Further exploration of system elements

While the 2040 concept already explored the various elements of the public transport system, the elements and areas explored were limited by my knowledge. Therefore, it would be valuable to further explore relevant elements to the system, preferably performing the exploration with individuals from different fields of knowledge and perspectives.

5.3 Reflection

Now, at the end of a project that lasted 10 month, I can look back and reflect on those 10 month. Here, I will share some of what I see, have learned, or think.

Project management

Something I already knew going into this project is that I struggle with managing projects, and myself. I run into scope creep, get tunnel vision, and have difficulties structuring my work and activities. Being in full control of this project has confronted me with this, yet it has also forced me to work on improving on my managing skills, deciding what is and isn't important, how to do certain things and helped me further realize and embrace the intuitive and slightly chaotic nature of my workflow. While I still have a long way to go, I can move forward with the knowledge that, while I might have struggled, in the end I did manage and complete this project.

The non-urban state of public transport

During this project, I became increasingly aware of the disparity in quality of public transport between urban and non-urban areas. While I had my own experiences with choosing, or rather choosing not to take public transport, I had never realised the true state of it, and with it, the necessity for change.

While I don't expect this project to change everything and provide THE solution, at the very least I hope that it can serve as a wake up call, opening the conversation on what can and should be done.

Passion for mobility

Early in my career, I would have said two things about myself as a designer. First, I would really like to work in the automotive industry. Second, I do not want to be a designer with the responsibility to change the world.

Now, I look at it in a different light. Rather than only vehicle design, I am really interested in mobility design as a whole, and would thus like to continue to design mobility that is focused on the experience of the people in my professional life as well. In designing mobility, I want to be provocative and disruptive, challenging why things are the way they are, and through it, change the world, if only on smaller scales.

References

-
- AlleCijfers. (2024). Alle adressen in Nederland: overzicht per gemeente. <https://allecijfers.nl/>
- Amblard, M. (2018, 8 maart). The Blurring Line between new Mobility Services and Public Transit. <https://www.linkedin.com/pulse/blurring-line-between-new-mobilityservices-public-transit-amblard/>
- Anderer, J. (2022, 10 mei). Hurry up! Modern patience thresholds lower than ever before, technology to blame. Study Finds. <https://studyfinds.org/hurry-up-modern-patience-thresholds-lower-than-ever-before-survey-finds/>
- Arends, J. (2024, 22 april). Vrijwilligerswerk 2023. Centraal Bureau Voor de Statistiek. <https://www.cbs.nl/nl-nl/longread/rapportages/2024/vrijwilligerswerk-2023>
- Azeez, M., Gambatese, J., & Hernandez, S. (2019). What Do Construction Workers Really Want? A Study about Representation, Importance, and Perception of US Construction Occupational Rewards. *Journal Of Construction Engineering And Management*, 145(7). [https://doi.org/10.1061/\(asce\)co.1943-7862.0001669](https://doi.org/10.1061/(asce)co.1943-7862.0001669)
- Bardt, H. (2017). Autonomous Driving — a Challenge for the Automotive Industry. *Intereconomics*, 52(3), 171–177. <https://doi.org/10.1007/s10272-017-0668-5>
- Bastiani, F. (2023, 3 oktober). What is the future for social interaction? *InnovatorsMag*. <https://www.innovatorsmag.com/what-is-the-future-for-social-interaction/>
- Bertoncello, M., & Wee, D. (2015, 1 juni). Ten ways autonomous driving could redefine the automotive world. McKinsey & Company. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/ten-ways-autonomous-driving-could-redefine-the-automotive-world>
- Boisseau, B. (2023, 6 januari). The major changes in vehicle ownership significantly impact the future of the automotive industry. *Ubuntu*. <https://ubuntu.com/blog/what-changing-vehicle-ownership-habits-and-mobility-trends-mean-for-the-future-of-the-automotive-industry>
- Boon, L. (2019). Onderzoek: jongeren behoefte aan digital detox. *MarketingTribune*. <https://www.marketingtribune.nl/b2b/nieuws/2019/03/onderzoek-jongeren-behoefte-aan-digital-detox/index.xml>
- Bruun, A., Jensen, R. H., Kjeldskov, J., Paay, J., Hansen, C. M., Sakáčová, K. L., & Larsen, M. H. (2020). Exploring the Non-Use of Mobile Devices in Families through Provocative Design. *DIS '20: Proceedings Of The 2020 ACM Designing Interactive Systems Conference*, 813–826. <https://doi.org/10.1145/3357236.3395428>
- Buchholz, K. (2024, 25 maart). Global staff shortages balloon in just six years [Infographic]. *Forbes*. <https://www.forbes.com/sites/katharinabuchholz/2024/03/15/global-staff-shortages-balloon-in-just-six-years-infographic/?ss=futureofwork>

Buitelaar, E., Bastiaanssen, J., Hilbers, H., 't Hoen, M., Husby, T., Lennartz, C., Van Der Staak, M., Snellen, D., & Weterings, A. (2021, 9 september). Thuiswerken en de gevolgen voor wonen, werken en mobiliteit. Planbureau Voor de Leefomgeving. <https://www.pbl.nl/publicaties/thuiswerken-en-de-gevolgen-voor-wonen-werken-en-mobiliteit>

Burchell, B., Deakin, S., Rubery, J., & Spencer, D. A. (2024). The future of work and working time: introduction to special issue. *Cambridge Journal Of Economics*, 48(1), 1–24. <https://doi.org/10.1093/cje/bead057>

Centraal Bureau Voor de Statistiek. (2018, 5 januari). Tevredener met het leven bij sterkere binding met buurt. <https://www.cbs.nl/nl-nl/nieuws/2018/01/tevredener-met-het-leven-bij-sterkere-binding-met-buurt>

Centraal Bureau voor de Statistiek. (2021). Nabijheid van OV-haltes (excl. trein) in 2020. <https://www.cbs.nl/nl-nl/maatwerk/2021/24/nabijheid-van-ov-haltes--excl-trein---in-2020>

Centraal Bureau voor de Statistiek. (2022). Nabijheid van OV-haltes (excl. trein) in 2020. <https://www.cbs.nl/nl-nl/maatschappij/verkeer-en-vervoer/ov-monitor/hoe-bereikbaar-is-het-ov/afstand-tot-het-station-en-autobezit-per-gemeente->

Centraal Bureau Voor de Statistiek. (2022a). Vergrijzing. <https://longreads.cbs.nl/regionale-prognose-2022/vergrijzing/>

Centraal Bureau Voor de Statistiek. (2022b, augustus 11). Trek uit de Randstad blijft toenemen. <https://www.cbs.nl/nl-nl/nieuws/2022/32/trek-uit-de-randstad-blijft-toenemen>

Centraal Bureau Voor de Statistiek. (2024a). Stedelijkheid (van een gebied). <https://www.cbs.nl/nl-nl/onze-diensten/methoden/begrippen/stedelijkheid-van-een-gebied>

Centraal Bureau Voor de Statistiek. (2024b, februari 20). Bijna 11,7 miljoen mensen hebben autorijbewijs. <https://www.cbs.nl/nl-nl/nieuws/2024/08/bijna-11-7-miljoen-mensen-hebben-autorijbewijs>

Centraal Bureau Voor de Statistiek. (2024c, mei 15). Brede welvaart jongvolwassenen blijft achter. <https://www.cbs.nl/nl-nl/nieuws/2024/20/brede-welvaart-jongvolwassenen-blijft-achter>

Chatterjee, K., Chng, S., Clark, B., Davis, A., De Vos, J., Ettema, D., Handy, S., Martin, A., & Reardon, L. (2019). Commuting and wellbeing: a critical overview of the literature with implications for policy and future research. *Transport Reviews*, 40(1), 5–34. <https://doi.org/10.1080/01441647.2019.1649317>

Chiao, D., Heineke, K., Kelkar, A., Kellner, M., Scarinci, E., Tolstinev, D., & Deichmann, J. (2024, 5 januari). Autonomous vehicles moving forward: Perspectives from industry leaders. McKinsey & Company. <https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/autonomous-vehicles-moving-forward-perspectives-from-industry-leaders>

-
- CIPD. (2022). Trends in flexible working arrangements. <https://www.cipd.org/en/knowledge/reports/flexible-working-trends/>
- CROW. (2021). Nabijheid en netwerken. <https://www.crow.nl/duurzame-mobiliteit/home/duurzaam-economisch-groeipotentieel/nabijheid-en-netwerken/>
- De Jong, R. (2019, 28 januari). EASCY: de vijf trends die de auto-industrie bepalen. Emerce. <https://www.emerce.nl/achtergrond/eascy-de-vijf-trends>
- Deci, E. L., & Ryan, R. M. (2000). The “What” and “Why” of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, 11(4), 227–268. https://doi.org/10.1207/s15327965pli1104_01
- Delbosc, A. (2012). The role of well-being in transport policy. *Transport Policy*, 23, 25–33. <https://doi.org/10.1016/j.tranpol.2012.06.005>
- Desmet, P., & Fokkinga, S. (2020). Beyond Maslow’s Pyramid: Introducing a Typology of Thirteen Fundamental Needs for Human-Centered Design. *Multimodal Technologies And Interaction*, 4(3), 38. <https://doi.org/10.3390/mti4030038>
- Eaves, S., Gyi, D., & Gibb, A. (2015). Building healthy construction workers: Their views on health, wellbeing and better workplace design. *Applied Ergonomics*, 54, 10–18. <https://doi.org/10.1016/j.apergo.2015.11.004>
- FEV. (2019). Personal Public Vehicle PPV. <https://magazine.fev.com/en/personal-public-vehicle-ppv/>
- FEV. (2021). Top Trends in Modular Electric Vehicle Design. <https://www.fev.com/en/media-center/blog/post/article/top-trends-in-modular-electric-vehicle-design.html>
- Francis, T. (2022). In defence of big screens: Merc UX design boss fights back. *Car Design News*. <https://www.cardesignnews.com/designers/in-defence-of-big-screens-merc-ux-design-boss-fights-back/43513.article>
- Friman, M., Gärling, T., Ettema, D., & Olsson, L. E. (2017). How does travel affect emotional well-being and life satisfaction? *Transportation Research Part A Policy And Practice*, 106, 170–180. <https://doi.org/10.1016/j.tra.2017.09.024>
- Garg, R. (2021). Understanding Families’ Non-/Use Practices and Choices: The Case of Smart Speakers and Smart Interactive Toys. *Proceedings Of The ACM On Human-Computer Interaction*, 5(CSCW2), 1–26. <https://doi.org/10.1145/3476036>
- Goudappel. (z.d.). Mobiliteitshub: zo helpt het bij uw mobiliteitstransitie. <https://www.goudappel.nl/nl/themas/mobiliteitshub>
- Gross, A. J., Murthy, D., & Varshney, L. R. (2017). Pace of Life in Cities and the Emergence of Town Tweeters. *SAGE Open*, 7(4). <https://doi.org/10.1177/2158244017745113>
- Heineke, K., Laverty, N., Möller, T., & Ziegler, F. (2023, 19 april). The future of mobility: Mobility evolves. McKinsey & Company. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-future-of-mobility-mobility-evolves>

-
- Hekkert, P., & Van Dijk, M. (2010). *VIP Vision in Design: A Guidebook for Innovators*. BIS Publishers.
- Hogan, V. (2024, 3 juni). Remote Work of The Future: 4 WFH Trends To Watch Out For. *Forbes*. <https://www.forbes.com/sites/ginnyhogan/2024/04/03/remote-work-of-the-future-4-wfh-trends-to-watch-out-for/>
- Hunziker, R., & De Giovanetti, L. (2022, 3 november). The World Business Council for Sustainable Development. The World Business Council For Sustainable Development. <https://www.wbcsd.org/Overview/News-Insights/WBCSD-insights/If-we-act-todaywe-can-halve-the-missions-of-the-builtenvironment-by-2030>
- Husby, T., Weterings, A., & Groot, J. (2019, 14 oktober). Trek van en naar de stad. Planbureau Voor de Leefomgeving. <https://www.pbl.nl/publicaties/trek-van-en-naar-de-stad>
- Iberdrola. (2021). Generation Alpha will lead a 100% digital world. <https://www.iberdrola.com/talent/alpha-generation>
- International Energy Agency. (2022, juni). World Energy Investment 2022. <https://www.iea.org/>
- Kara-Yakoubian, M. (2022, 17 januari). Massive meta-analysis finds loneliness has increased in emerging adults in the last 43 years. *PsyPost - Psychology News*. <https://www.psypost.org/2022/01/massive-meta-analysis-finds-loneliness-hasincreased-in-emerging-adults-in-the-last-43-years-62377>
- Kooyman, J. (2019, 1 februari). De nieuwe elite onderscheidt zich met yoga, podcasts en havermelk. *NRC*. <https://www.nrc.nl/nieuws/2019/01/31/de-nieuwe-elite-onderscheidt-zich-met-yoga-podcasts-en-havermelk-a3652474>
- Kroep, D. (2022, 22 augustus). How Work-Life Balance is Changing: Trends and Risks to Look Out For. *OpenUp*. <https://openup.com/self-guided-care/blog/work-life-balance-changing-trends-and-risks/>
- Lightyear. (2022). Clean mobility is built into our DNA - How our cars tap into human instinct. <https://lightyear.one/articles/clean-mobility-is-built-into-our-dna-how-our-cars-tap-into-human-instinct>
- Liu, J., Ettema, D., & Helbich, M. (2022). Systematic review of the association between commuting, subjective wellbeing and mental health. *Travel Behaviour And Society*, 28, 59–74. <https://doi.org/10.1016/j.tbs.2022.02.006>
- London Datastore. (2018). Public transport accessibility levels – London Datastore. <https://data.london.gov.uk/dataset/public-transport-accessibility-levels>
- Lumley, S. (2023, 17 april). Thousands of drivers “overwhelmed” by car’s tech features - like cruise control. *Wales Online*. <https://www.walesonline.co.uk/news/uk-news/cars-driving-technology-hyundai-quiz-26714268>
- Madgavkar, A., Manyika, J., Smit, S., & Ellingrud, K. (2021, 18 februari). The future of work after COVID-19. <https://www.mckinsey.com/featured-insights/future-of-work/the-futureof-work-after-covid-19>

Manyika, J., Lund, S., Chui, M., Bughin, J., Woetzel, J., Batra, P., Ka, R., & Sanghvi, S. (2017, 28 november). Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages. McKinsey & Company. <https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages>

Maurer, M., Gerdes, J. C., Lenz, B., & Winner, H. (2016). Autonomous driving. In Springer eBooks. <https://doi.org/10.1007/978-3-662-48847-8>

McGregor, J. (2024a, april 15). Job 'Engagement' scores just hit an 11-Year low. Gen Z's fell the most. Forbes. <https://www.forbes.com/sites/jenamcgregor/2024/04/10/worker-engagement-just-hit-an-11-year-low-gen-zs-numbers-fell-the-most/?ss=futureofwork>

McGregor, J. (2024b, mei 9). Four-Day workweeks include 'You Do You' days at this company. Forbes. <https://www.forbes.com/sites/jenamcgregor/2024/04/01/four-day-workweeks-include-you-do-you-days-at-this-company/?ss=futureofwork>

McKinsey & Company. (2021, 12 november). The future of interior in automotive. <https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-future-of-interior-in-automotive>

McKinsey & Company. (2022, 24 oktober). Smartphones on wheels: New rules for automotive product development. <https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages>

Moldovan, N. (2022, 17 augustus). Take a Walk: The Cities Around Europe That Are Banning Cars. Europe Of Cities. <https://www.europeofcities.com/blog/take-a-walk-cities-banning-cars>

Mulalic, I., & Rouwendal, J. (2020). Does improving public transport decrease car ownership? Evidence from a residential sorting model for the Copenhagen metropolitan area. *Regional Science And Urban Economics*, 83, 103543. <https://doi.org/10.1016/j.regsciurbeco.2020.103543>

Naaktgeboren, D. (2024, 1 februari). Rijk remt investeringen in openbaar vervoer af: 'Vroemvroembeleid bijna een godsdienst'. AD. <https://www.ad.nl/binnenland/rijk-remt-investeringen-in-openbaar-vervoer-af-vroemvroembeleid-bijna-een-godsdienst~ae65d949/>

NCSL. (z.d.). Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation. <https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehiclesenacted-legislation>

NielsenIQ. (2018). Was 2018 the year of the influential sustainable consumer? <https://nielseniq.com/global/en/insights/analysis/2018/was-2018-the-year-of-the-influential-sustainable-consumer/>

OliverWyman. (z.d.). How car ownership may become relic. <https://www.oliverwyman.com/our-expertise/insights/2020/jun/automotive-industry-at-the-crossroads/customers-sales-and-services/how-car-ownership-may-become-relic.html>

Ortiz-Ospina, E., & Roser, M. (2024, 18 maart). The rise of social media. Our World in Data. <https://ourworldindata.org/rise-of-social-media>

OV in Nederland Wiki. (2024a). Concessie Noord-Holland Noord (2018-2028). [https://wiki.ovinnederland.nl/wiki/Concessie_Noord-Holland_Noord_\(2018-2028\)](https://wiki.ovinnederland.nl/wiki/Concessie_Noord-Holland_Noord_(2018-2028))

OV in Nederland Wiki. (2024b). Mercedes-Benz Sprinter. https://wiki.ovinnederland.nl/wiki/Mercedes-Benz_Sprinter

OV-Magazine. (2015). Imago ov onder niet-gebruikers beroerd. <https://www.ovmagazine.nl/nieuws/imago-ov-onder-niet-gebruikers-beroerd>

Pandremenos, J., Paralikas, J., Salonitis, K., & Chryssolouris, G. (2008). Modularity concepts for the automotive industry: A critical review. *CIRP Journal Of Manufacturing Science And Technology*, 1(3), 148–152. <https://doi.org/10.1016/j.cirpj.2008.09.012>

Provincie Noord-Holland. (2023). Hubstrategie provincie Noord-Holland. https://www.noord-holland.nl/Onderwerpen/Verkeer_vervoer/Smart_Mobility/Documenten/Hubstrategie_provincie_Noord_Holland

Provincie Noord-Holland. (2024a). Buurtbussen in Noord-Holland. https://www.noord-holland.nl/Onderwerpen/Verkeer_vervoer/Openbaar_vervoer/Buurtbussen_in_Noord_Holland

Provincie Noord-Holland. (2024b). Omgevingsvisie NH2050. https://www.noord-holland.nl/Onderwerpen/Ruimtelijke_inrichting/Projecten/Omgevingswet/Omgevingsvisie

Provincie Noord-Holland. (2024c). Ontwikkelperspectief OV Noord-Holland Noord. https://www.noord-holland.nl/Onderwerpen/Verkeer_vervoer/Openbaar_vervoer/Beleidsdocumenten/Ontwikkelperspectief_OV_Noord_Holland_Noord

Provincie Noord-Holland. (2024d). Openbaar vervoer. https://www.noord-holland.nl/Onderwerpen/Verkeer_vervoer/Openbaar_vervoer

Provincie Noord-Holland & De Ruijter Strategie. (2024). Strategische inzichten: Scenario's Slimme Mobiliteit Noord-Holland 2050.

PwC. (2017). Five trends transforming the Automotive Industry. <https://www.pwc.com/gx/en/industries/automotive/publications/eascy.html>

Reuters. (2024, 17 januari). Workers view work-life balance as more important than pay, study finds. <https://www.reuters.com/business/workers-view-work-life-balance-more-important-than-pay-study-finds-2024-01-17/>

Ritchie, H., & Roser, M. (2024, 18 maart). Which form of transport has the smallest carbon footprint? Our World in Data. <https://ourworldindata.org/travel-carbon-footprint>

Rogalski, M. (z.d.). The future of modular cars. The Retail Performance Company. https://www.rpc-partners.com/germany_en/insights/the-modular-future-of-cars.html

Roussi, P., Rapti, F., & Kiosseoglou, G. (2006). Coping and psychological sense of community: An exploratory study of urban and rural areas in Greece. *Anxiety Stress & Coping*, 19(2), 161–173. <https://doi.org/10.1080/10615800600593304>

SAE International. (2021). SAE Levels of Driving Automation & Refined for Clarity and International Audience. <https://www.sae.org/blog/sae-j3016-update>

-
- Santos, H. C., Varnum, M. E. W., & Grossmann, I. (2017). Global increases in individualism. *Psychological Science*, 28(9), 1228–1239. <https://doi.org/10.1177/0956797617700622>
- Schlüter, J., Bossert, A., Rössy, P., & Kersting, M. (2020). Impact assessment of autonomous demand responsive transport as a link between urban and rural areas. *Research in Transportation Business & Management*, 39, 100613. <https://doi.org/10.1016/j.rtbm.2020.100613>
- Sedee, M. (2022, 28 oktober). Een kind krijgen, zo kan het ook. NRC. <https://www.nrc.nl/nieuws/2022/10/28/een-kind-krijgen-zo-kan-het-ook-a4146489>
- Slagter, L. (2021, 13 december). Hoe ziet de toekomst van het vrijwilligerswerk eruit? Vrijwilligers Centrale Amsterdam. <https://www.vca.nu/toekomst/>
- Sociaal en Cultureel Planbureau. (2023a, juli 12). Sombere over de samenleving? <https://www.scp.nl/publicaties/publicaties/2023/05/24/somber-over-de-samenleving>
- Sociaal en Cultureel Planbureau. (2023b, augustus 9). Samenleving in beweging. <https://www.scp.nl/publicaties/publicaties/2023/08/07/samenleving-in-beweging>
- Sociaal en Cultureel Planbureau. (2024a, april 4). De leefwerelden van arm en rijk. <https://www.scp.nl/publicaties/publicaties/2024/04/05/de-leefwerelden-van-arm-en-rijk>
- Sociaal en Cultureel Planbureau. (2024b, september 5). Gezien, gehoord en geholpen willen worden. <https://www.scp.nl/publicaties/publicaties/2023/08/25/gezien-gehoord-en-geholpen-willen-worden>
- Statista. (2023, 28 april). Willingness towards sustainable living 2021. <https://www.statista.com/statistics/1264572/efforts-to-live-sustainably-china-us-uk/>
- Stewart, R., Charles, M. B., & Page, J. (2023). A future with no individual ownership is not a happy one: Property theory shows why. *Futures*, 152, 103209. <https://doi.org/10.1016/j.futures.2023.103209>
- SWOV. (2021). Public transport - Why are seatbelts not mandatory in public transport? <https://swov.nl/en/fact/public-transport-why-are-seatbelts-not-mandatory-public-transport>
- Thomas, L. (2023, 22 augustus). The future of car ownership. Confused.com. <https://www.confused.com/meet-our-experts/content/the-future-of-car-ownership>
- Torchinsky, J. (2021, 8 april). Consumers Should Demand EVs That Are Built Like PCs. Gizmodo. <https://www.gizmodo.com.au/2021/04/consumers-should-demand-evs-built-like-pcs-even-if-carmakers-dont-want-it/>
- Trommels, F. (z.d.). In 2030, working on your own mental health will be the most natural thing in the world. Tilburg University. <https://www.tilburguniversity.edu/magazine/2030-working-your-own-mental-health-will-be-most-natural-thing-world>
- United Nations. (z.d.). Ageing. <https://www.un.org/en/global-issues/ageing>
- Van Outeren, E. (2024, 22 oktober). Niet alleen tennisser Djokovic gelooft in de mythische piramides van Bosnië. NRC. <https://www.nrc.nl/nieuws/2022/10/28/niet-alleen-tennisser-djokovic-gelooft-in-de-mythische-piramides-van-bosnie-2-a4146508>



-
- Vis, C. (2022, 21 november). Hoe kun je je kinderen in tijden van klimaatcrisis hoopvol opvoeden? NRC. <https://www.nrc.nl/%20nieuws/2022/11/14/hoe-kun-je-je-kinderen-in-tijden-van-klimaatcrisis-hoopvol-opvoeden-a4148199>
- Volkswagen Group. (2019). Volkswagen: Sound Design. <https://www.volkswagenag.com/en/news/stories/2019/03/volkswagen-sound-design.html>
- Volkswagen Group. (2021, 1 december). "Self-driving vehicles are becoming a means of public transport". <https://www.volkswagenag.com/en/news/stories/2021/12/self-driving-vehicles-are-becoming-a-means-of-public-transport.html>
- Vollset, S. E., Goren, E., Yuan, C., Cao, J., Smith, A. E., Hsiao, T., Bisignano, C., Azhar, G. S., Castro, E., Chalek, J., Dolgert, A. J., Frank, T., Fukutaki, K., Hay, S. I., Lozano, R., Mokdad, A. H., Nandakumar, V., Pierce, M., Pletcher, M., Murray, C. J. L. (2020). Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. *The Lancet*, 396(10258), 1285–1306. [https://doi.org/10.1016/s0140-6736\(20\)30677-2](https://doi.org/10.1016/s0140-6736(20)30677-2)
- Wang, Y., & Gao, Y. (2022). Travel satisfaction and travel well-being: Which is more related to travel choice behaviour in the post COVID-19 pandemic? Evidence from public transport travellers in Xi'an, China. *Transportation Research Part A Policy And Practice*, 166, 218–233. <https://doi.org/10.1016/j.tra.2022.10.003>
- Watney, C. (2018, 3 maart). Slowing down driverless cars would be a fatal mistake. R Street Institute. <https://www.rstreet.org/2018/03/03/slowing-down-driverless-cars-would-be-a-fatal-mistake/>
- Wikipedia. (2024a). Concessies in het Nederlandse openbaar vervoer. https://nl.wikipedia.org/wiki/Concessies_in_het_Nederlandse_openbaar_vervoer
- Wikipedia. (2024b). Tabel van gemeenten in Noord-Holland. https://nl.wikipedia.org/wiki/Tabel_van_gemeenten_in_Noord-Holland
- Zijlstra, Bakker, & Witte. (2022a). The widespread car ownership in the Netherlands. <https://english.kimnet.nl/publications/publications/2022/02/22/the-widespread-car-ownership-in-the-netherlands>
- Zijlstra, T., Bakker, S., & Witte, J. (2022b, februari 22). Verschillen in autoafhankelijkheid tussen stad en land groeien. Kennisinstituut Voor Mobiliteitsbeleid. <https://www.kimnet.nl/actueel/nieuws/2022/02/22/verschillen-in-autoafhankelijkheid-tussen-stad-en-land-groeien>



Appendices

Appendix A. Project brief	85	Appendix H. Interview informed consent sheet	100
Appendix B. Nearest train station	88	Appendix I. Expanded personas	102
Appendix C. Nearest public transport stop	89	Appendix J. Context factors	107
Appendix D. Automotive technology	90	Appendix K. Clustering	113
Appendix E. Observation plan	93	Appendix L. Expanded future profiles	117
Appendix F. Observation Notes	94	Appendix M. Ideation materials	122
Appendix G. Interview plan	99		

Appendix A. Project Brief



IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project.

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Boon	IDE master(s)	IPD <input type="checkbox"/> Dfi <input checked="" type="checkbox"/> SPD <input type="checkbox"/>
Initials	D.	2 nd non-IDE master	
Given name	Dani	Individual programme (date of approval)	
Student number	4552822	Medisign	<input type="checkbox"/>
		HPM	<input type="checkbox"/>

SUPERVISORY TEAM

Fill in the required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Euiyoung Kim	dept./section	DOS / MCR
mentor	Elmer van Grondelle	dept./section	HCD / DA
2 nd mentor	John Steendijk		
client	Provincie Noord-Holland		
city	Haarlem	country	Netherlands
optional comments			

Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in by the Chair of the supervisory team

Sign for approval (Chair)

Name Euiyoung Kim Date 13 Mar 2024 Signature

Digital signed by: Euiyoung Kim
Chair: 037607C-A05E-6C2D-
B0F4-0E23D3331887
Date: 2024/03/13 15:54:30
+01'00'

CHECK ON STUDY PROGRESS

To be filled in by SSC E&SA (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total	EC	YES	all 1 st year master courses passed
Of which, taking conditional requirements into account, can be part of the exam programme	EC	NO	missing 1 st year courses

Comments:

Sign for approval (SSC E&SA)

Name Date Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	Supervisory Team approved
NO	Supervisory Team not approved

Comments:

Based on study progress, students is ...

ALLOWED to start the graduation project
NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Name Date Signature

Personal Project Brief – IDE Master Graduation Project

Name student **Dani Boon**

Student number **4,552,822**

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title **Designing autonomous first/last-mile demand-responsive transport for emotional wellbeing in 2030 Noord-Holland**

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

Introduction

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

When discussing the topic of smart mobility, the focus is often laid on its role and potential within a city, and how it could support the existing mobility system. This interconnected system of different modes of transport allow travellers to effortlessly move through the city.

Sadly, the same cannot be said for non-urban areas. Wider regions and lower population densities often stretch a mobility system thin, requiring compromises to be made. These compromises lead to issues in the accessibility, and ultimately, the liveability of these non-urban areas.

Within this project, which will be done in collaboration with the Provincie Noord-Holland, the use of smart mobility in the form of autonomous demand responsive transport will be explored for the non-urban areas of Noord-Holland. The goal is to create a concept designed for the emotional wellbeing of travellers. As the intention of this project is to design for innovation, research will be done to look further into the future. The concept will be designed to fit this future of mobility, with a final focus on the year 2030.

The main stakeholders are the travellers who are unable or unwilling to use personal transport, and thus have to rely on public transport for their mobility. The vehicle could be tied directly to the freedom these travellers experience, and could broaden their accessible world. The second main stakeholder is the Provincie Noord-Holland, which is in large part responsible for this mobility system. Their challenges lies in balancing the costs of operating and maintaining the system with the wants and needs of the travellers.

Finally, travellers who are able to rely on personal transport, and thus are not using public transport will also be considered, as providing them with an appealing alternative to personal transport could provide further benefits.

→ space available for images / figures on next page

introduction (continued): space for images

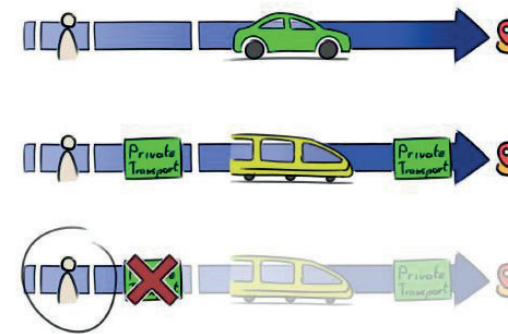


image / figure 1 Different travellers, and their journeys, as well as the type of traveller I wish to focus on.

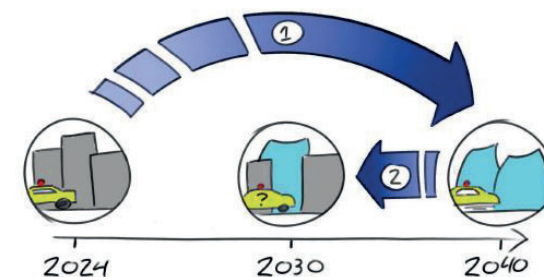


image / figure 2 The general outline of the project. Analyze the present, construct the far future and return to close future.



Personal Project Brief – IDE Master Graduation Project

Problem Definition

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

The current problem is that a lack of mobility options in non-urban areas (in Noord-Holland) lead to a lower accessibility and liveability compared to the urban areas (Provincie Noord-Holland, 2021). Autonomous demand responsive transport could be a solution for this problem, and while its application is predominantly focused on urban areas, the potential role of autonomous DRT for non-urban areas is also being investigated (Schlüter et al, 2021).

In these investigation, the focus predominantly lies the question whether the use of autonomous DRT in these cases is feasible and viable, while the question of whether their use is actually desirable is often overlooked (Wong et al, 2023).

As such, this project will focus on the experiences of the (future) travellers, and investigate the role of an autonomous DRT vehicle in creating a pleasant journey for traveller in the future of non-urban Noord-Holland.

The solution space is to be a concept for a vehicle to fulfil the earlier established role, and emotional needs of the future travellers. This concept will be focused on the interior, as well as the interaction with the travellers.

Assignment

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

Design a use concept (and requirements of its implementation) of an autonomous DRT vehicle that fulfils the required role established by the wants and needs of the travellers in non-urban 2030 Noord-Holland.

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

Through the use of an adapted version of the VIP methodology, with extra focus on emotional wellbeing, a vision is created for the future of mobility in non-urban Noord-Holland in 2040. Along with this vision for the context, another vision is created for the emotional needs of the future travellers, through the application of the Fundamental Needs framework. Based on these visions, an advanced concept for an autonomous DRT vehicle in 2040 is designed.

Afterwards, based on the 2040 advanced concept, and current day autonomous DRT vehicles, an intermediate concept is created for an autonomous DRT vehicle in 2030, allowing the vehicle to be grounded in reality, yet innovative as well.

Project planning and key moments

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

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

Kick off meeting 12 mrt 2024

Mid-term evaluation 14 mei 2024

Green light meeting 12 aug 2024

Graduation ceremony 16 sept 2024

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

Part of project scheduled part-time	<input checked="" type="checkbox"/>
For how many project weeks	25
Number of project days per week	4,0

Comments:

This is a healthier workload for me, and with working 4 days instead of 5, I feel it is more feasible for me to finish the project within 25 weeks.

Motivation and personal ambitions

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

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

1. Experience the field: The predominant motivation for me to create and start this specific project is that I want to experience working in the field of mobility to see whether this field fits me, and if so, if I could play a meaningful role within this industry.
2. Future context creation: I want to gain more experience in both creating future visions, as well as creating FOR these future visions. To this goal, I want to work more with VIP to not only use it efficiently, but use it in a way that suits me.
3. Emotion design(er): I want to apply the methodology of designing for emotion, to gain more experience in this methodology, and grow as an empathic designer.
4. Communicating result: In this project with multiple stakeholders, I want to work on my abilities to clearly communicate the results I generate.
5. Project management: In the this project I want to become better at managing both the project to make sure I hit the deadlines set and generate results on time, but also myself so that I can maintain a healthy work-life balance.

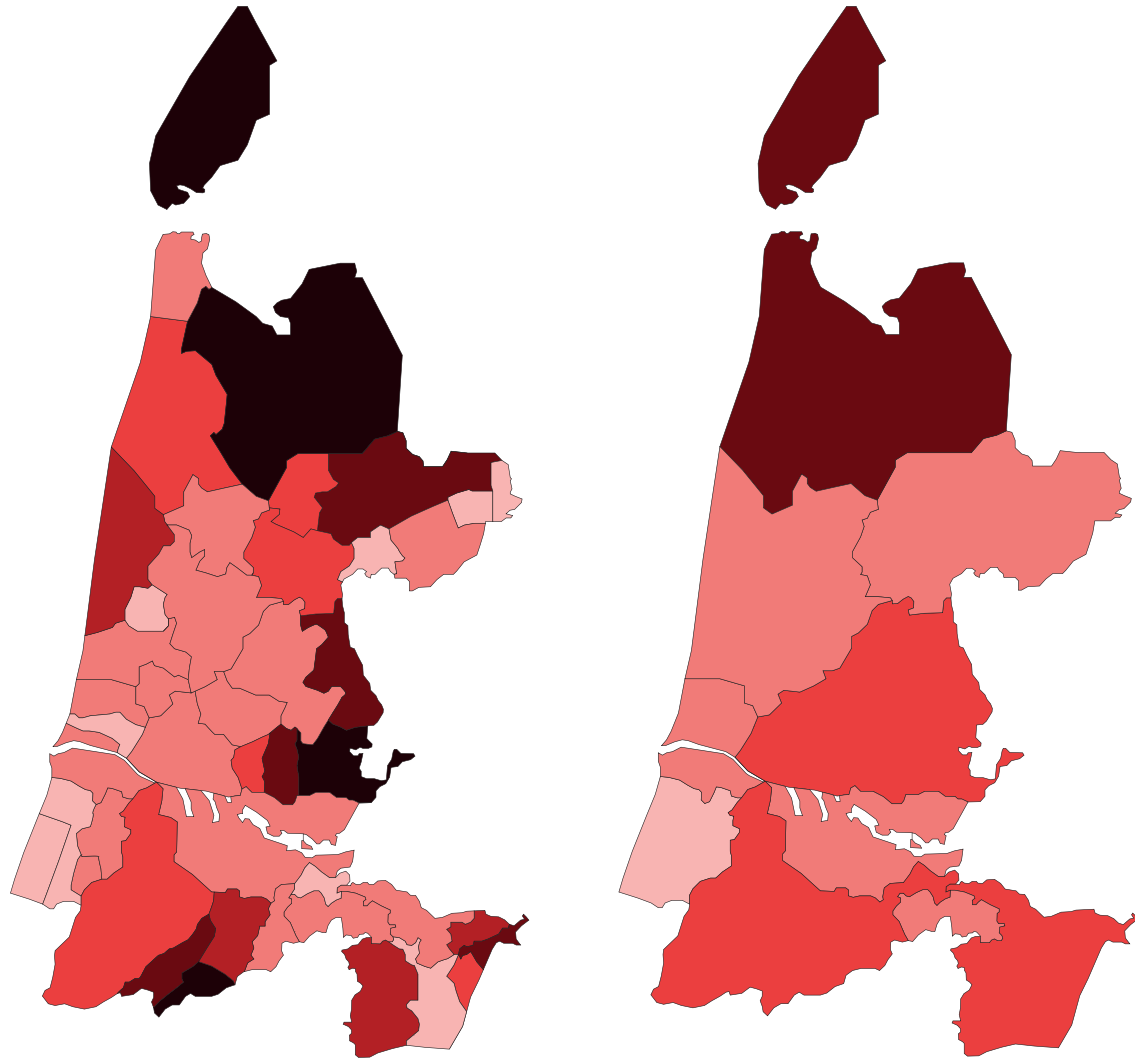
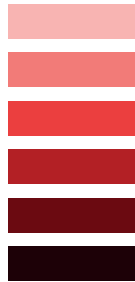
Appendix B. Nearest train station

Nearest train station in Noord-Holland

How far do you have to travel on average to reach the closest train station? Here, we look at how long one would need to travel (on the road) to reach the closest train station. The average for each municipality is taken, as given by the CBS (CBS, 2022).

Legend

0 - 2 km
2 - 4 km
4 - 6 km
6 - 8 km
8 - 10 km
10+ km

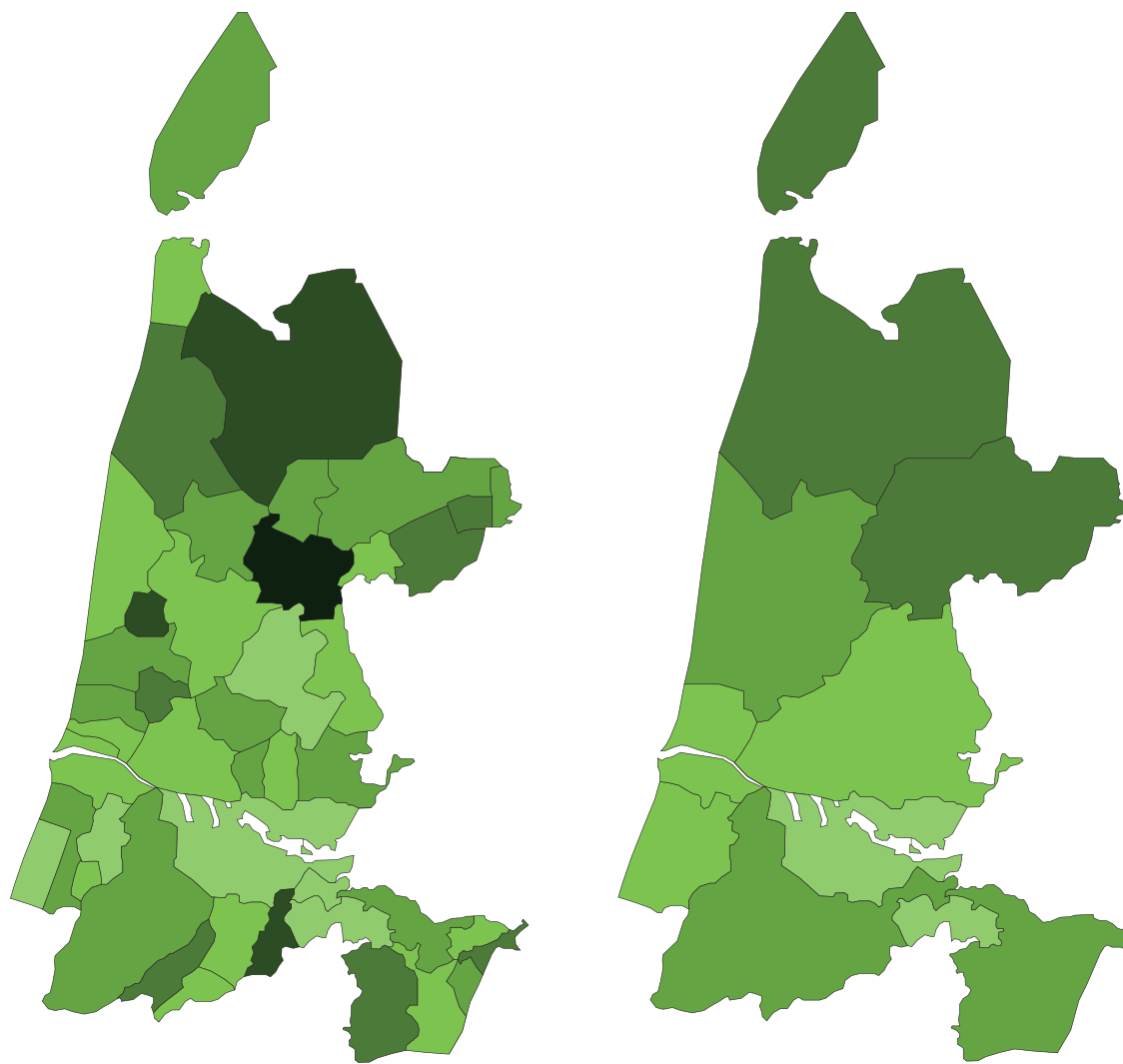
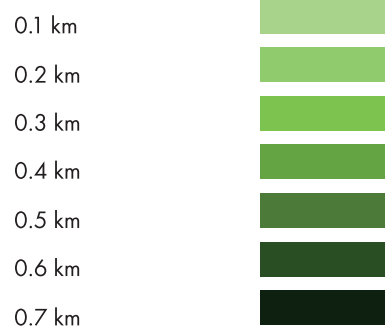


Appendix C. Nearest public transport stop

Nearest public transport stop in Noord-Holland

How far do you have to travel on average to reach the closest public transport stop (excluding train stations)? Here, we look at how long one would need to travel (on the road) to reach the closest public transport stop. The average for each municipality is taken, as given by the CBS (CBS, 2021).

Legend



Appendix D. Automotive technology

The third topic of research delves into technological advancement, specifically those related to the automotive industry and public transportation, and highlights how these developments may influence the future of public transportation.

Eascy

The third topic of research delves into technological advancement, specifically those related to the automotive industry and public transportation, and highlights how these developments may influence the future of public transportation.

Electrified

With sustainability in mobility being an increasingly important topic, the transition from fuel vehicles to electric vehicles continues to progress. Here, fleet based operations, like buses, provide an interesting opportunity to further empower this transition.

While part of the fleet of Connexxion in Noord-Holland Noord are already electric, this share will continue to increase in size until all vehicles under Connexxion drive electrically.

This may however bring a challenge with it as the range of an electric vehicle could be more limited than that of a fuel powered one, leading to optimizations needing to be made in the bus schedule, or alternative compromises to be made.

Autonomous

While fully autonomous vehicles which are ready for the public road are still some time away, vehicles are more and more equipped with technologies and features supporting the drivers, with partial autonomous driving (in semi controlled environments) already being possible.

As these driver supports take over more of the tasks of the driver towards the future, the role of the driver could begin to change from driver to overseer to passenger.

Similarly, the role of the bus driver could change as well, allowing for new opportunities and roles for the drivers to be explored.

Shared

With more and better alternatives to vehicle ownership arising, future travellers might no longer feel the need to own personal vehicles, and instead feel confident to rely on the professionally managed shared alternatives.

While public transport could already be seen as a form of shared mobility, this idea can be taken further, with passengers in a public transport network taking on a different role as well, and becoming more involved.

Connected

As vehicles become increasingly equipped with smart technologies, they themselves become smarter as well, allowing for expanded functionality, making the experience for the passenger more convenient, or altering and enriching the experience in a different manner.

Yearly updated

With more software and technology being developed and implemented in vehicles, an emphasis arises to have these vehicles be adaptable and able to be fitted with these new developments.

This allows for the buses to be more adaptable, and allowing it to change over time to always best suit the current needs of the users.

Autonomous driving

As we move further into the future, driver supports and autonomous driving becomes more effective, until full autonomous driving becomes possible and widely available. To help distinguish the level of automation in a vehicle, the Society of Automotive Engineers (SAE) (2014) has defined the automation of vehicles in six distinct levels, ranging from no assistance, to full driving automation. The levels represent the different steps in the ability of vehicles to operate without human control or intervention.

- **Level 0: No driving automation:** The vehicle cannot assist and the driver is in complete control of the vehicle at all times.
- **Level 1: Driver assistance:** The vehicle can assist with either steering or acceleration and deceleration, but the human is responsible for the other aspects of driving and must supervise the vehicle.
- **Level 2: Partial driving automation:** The vehicle can assist with both steering and acceleration and deceleration in certain conditions, but the driver must supervise the vehicle and be prepared to take over at any time.
- **Level 3: Conditional driving automation:** The vehicle can perform most driving tasks, monitor the driving environment and can handle specific scenarios independently, but the driver must be prepared to take over when the system requests.
- **Level 4: High driving automation:** The vehicle can perform all driving tasks independently within certain environments, and the driver is not required to intervene.
- **Level 5: Full driving automation:** The vehicle is fully autonomous and can perform all driving tasks under all conditions independently, and the driver is not required to intervene.

Within the time scope of the project, the general available level of autonomous driving will increase, yet as the shift to higher level automation takes longer than expected (McKinsey, 2024), it is unlikely to reach level 5, and allow for fully autonomous driving. Therefore, going forward, the presence of autonomous driving features in future public transport must be assumed and accounted for.

Demand responsive transport

Demand responsive transport is an alternative approach to public transport where, instead of operating by fixed routes or time tables, the vehicles alter and adjust their routes and journeys to better suit actual demand from travellers.

As a typical use case of demand responsive transport is to provide transport services to areas where there is low traveller demand and operating large scale fixed bus lines is not viable, such as non-urban areas, it is highly relevant and interesting to explore and include in this project.

However, DRT services are often not part of the regular public transport system as of yet, and where this implementation of demand responsive transport into the regular public transport system is explored, it is predominantly focussed on urban areas (Schlüter et al, 2021) to improve efficiency and lower operating costs.

Although the opportunities of using demand responsive transport in non-urban areas is being investigated, these researches focus on whether it is viable and feasible to do so, while overlooking the question of whether it is actually desirable to do so from the travellers perspective (Wong et al, 2023), often leading to a more efficient and effective system that is undesirable to use for the traveller.

While there currently are demand responsive transport services available within Noord-Holland Noord, even ones that are offered by Connexxion themselves, these services are regarded as a supplement to the regular public transport network, rather than an integral part of it. Still, the implementation of a demand responsive transport system for public transport in Noord-Holland Noord could still be a valuable element in designing the system to better suit the needs of the travellers.

Appendix E. Observation plan

What, who and where?

Where to observe?

- In and around the bus(stops) in municipality Drechterland and Hollands Kroon.

What to observe?

- Actions, interactions and behaviours of travellers who use the bus(stops).
- The context of these interactions themselves. Such as:
 - The bus
 - The bus stop
 - The surroundings of the bus stop

Who to observe?

- People who use or interact with the bus
- People who use or interact with the bus stops
- People who are in the vicinity of the bus stops
- Bus drivers

Criteria

How long?

- I plan to spend one full work day in each context
- I plan to spend some time in the bus, some at bus stops, and some in other hotspots (such as train station with bus stops close by). The exact time is not determined, but to ensure a richer set of observations, a switch in context will be made frequently.

What to explore?

- Explore the different contexts themselves, what do these offer, what are elements that might influence the interactions here.
- Explore who might be the travellers, and potential users.

Appendix F. Observation notes and pictures

Observations Hollands Kroon

What did I see?

- Municipality Hollands Kroon has placed 5 shared bikes at the (only) train station in the municipality. Everyone is able to use these, but employees at the municipality say that they only ever seen 3 bikes in use.
- In the municipality there is one bus line, which is a community bus, driven by volunteers. This bus drives once per hour.
- The travellers I've seen in transit were mostly children/students, who needed to travel further to reach their schools.

Spontaneous interviews

In municipality Hollands Kroon, I performed semi-structured interviews with people. In total, I spoke to 15 people.

- Of the 15 people, 12 did not use public transport.
 - The people noted various reasons for this, most of which came down to having access to a car, or bike.
 - One participant noted that public transport had an influence on the choice of education for her daughter.
 - People labelled the lacking presence of a bus limiting.
 - One participant said they the difference between city and rural areas very unfair.

Quotes

- "Thankfully not!" - a man when asked whether he used public transport.
- "I live too far removed from the network." - a woman when asked why she doesn't use public transport.
- "It's too much hassle to do, the travel time is too big and you can't go directly." - an elderly couple when asked why they don't use public transport.
- "I find it very crooked that out here, you have to be happy with a bus once an hour, while the city gets way more options." - a woman when talking about the public transport system in Hollands Kroon
- "I didn't know what was happening to me, the difference I experienced between here and Amsterdam." - a women when asked what she thought of the public transport system in Hollands Kroon.



General info

I travelled and observed for 5 hours. In this time, I observed from inside bus 412, and at the 3 train stations / transfer station on line 412, namely station Hoogkarspel, station Bovenkarspel-Grootebroek and station Hoorn.

My journey

Venhuizen --> Bus 412 --> Bovenkarspel-Grootebroek --> Bus 412 --> Hoogkarspel --> Bovenkarspel-Grootebroek --> Hoorn

Travellers

During the time I was travelling (2 hours), I took note of who else was sitting in the bus with me (and the driver). The majority of the time I was alone, but in total I was (at different times) joined by 23 other travellers, 21 of which looked to be students, one looked to be working, and one looked to be retired.

Bus 412

General observations

While based on vehicle which is originally not a bus, the modifications do make it feel like a professional and proper bus. It does however look a bit "industrial" with exposed bolts and rails.

The use of colour in the bus is very limited, with it mainly using shades of grey. The use of colour is mostly informative.

The seats are only slightly comfortable, and the ride was quite bumpy and shaky.

The seats looked clean, but the floor did not, a lot of small debris was strewn about.

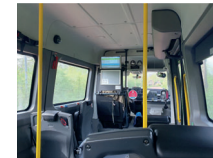
Bus driver

Besides simply driving the bus, being a bus driver is also a very social role. The bus driver received some friendly waves from people outside of the bus, and one time accidentally stopped when mistaking this friendly gesture as someone hailing the bus. Additionally, the bus driver was very talkative, and made conversation with his passengers, as well as myself.

Bus stops, and bus shelters

During my travels, I noticed a disparity in the bus stops, with some clearly receiving more resources than others. Of the 42 stops along bus line 412, 28 had no shelter at all, and were merely poles with signs and posters on them. 9 Stops had only a shelter in one direction, the other again being a simple pole. And only 5 stops had shelter a both direction.

Additionally, some bus stops even lacked a sidewalk or platform to stand and safely wait for the bus.



Bovenkarspel-Grootebroek station

Bovenkarspel-Grootebroek train station is one of the final stops of line 412.

The stop has one bus shelter, which was broken and vandalised, no waiting room, and an open but supposedly guarded bike storage, although the camera was nowhere to be seen.

The bus stop was placed at a relative busy road, and quite open and public area, with a shopping mall right adjacent to it.

The bus was too early at the train station, requiring the travellers to wait for 17 minutes, which for many could be the complete duration of their journey towards this train station by other transport means.



Hoogkarspel station

Hoogkarspel station is a train station along the route of bus 412.

This stop had no shelter, nor a waiting room for the train. It had an open and unguarded bike storage, where a sign recommended locking your bike to prevent it getting stolen. Additionally, the bike storage had bike vaults.

The bus stop was placed on a quiet and secluded road. While the area was quite open, it was also enclosed through trees and shrubbery, limiting visibility from outside the area.

The bus (from Bovenkarspel) did arrive at a favourable time to catch the train towards Maastricht.

One traveller chose to call a taxi, rather than bike or use the bus.

The train arrived, and 50-60 people departed. Of these people, around 2/3 continued their journey through personal transport (bike, walking or car). 1/3 Of the travellers were picked up, and only 1 traveller took the bus.

Hoorn station

Hoorn station is the other final stop of line 412. It is a bigger station with several trains and buses (R-Net, city buses, regional buses and community buses) departing from here.

The stop has a lot of shelter available, as well as a waiting room and stores at the station. The station had closed, guarded bike storage.

A lot of travellers opt to take the bus, estimated to be around 50%.

There are a lot of options to continue your journey; car, bike, bus, taxi, shared car or by foot.

There is a constant flow of buses coming and going.

Next to the station there is a city park, as well as the city center at walking distance.

There are a lot of people around, constant buzz.





Appendix G. Interview plan

Public transport users

Interview Goal

Learn about the user and the usage of the public transport system in Noord-Holland Noord, the reasons why users opt to use the system or not, what their opinions are of the system, and what their needs are.

Research questions public transport users

1. Who are the (public transport) travellers in Noord-Holland Noord?
2. How do these travellers use public transport?
3. What are the motivations for these travellers to choose for or against using public transport?
4. How do these travellers perceive public transport?
5. What are their struggles relating to public transport?
6. What do these travellers miss in public transport?

Interview Protocol

Interview Protocol for Public Transport Travellers in Noord-Holland Noord

1. Introduction

"Hello, and thank you for joining me today. My name is Dani, and I'm conducting a study into public transport travellers in the region [Noord-Holland Noord]. During our conversation, I'd like to learn about how you use and view public transport, as well as what your motivations and possible struggles might be.

Before we start, I need to ask your consent for participation in this research. Participation is entirely voluntary, and you can choose to skip any question, or end the interview at any time. If at any time you feel uncomfortable, please tell me, and we'll find a suitable solution.

Additionally, I want to assure you that everything we discuss today will be kept completely confidential. Your responses will be used solely for research purposes, and all identifiable data will be anonymised. Finally, after the project has finished, all data will be destroyed. If you are comfortable with all of this, do I have your consent to continue with the interview?"

2. Participant background

- 2.1 Can you tell me a bit about yourself? (e.g., age, occupation, daily activities)
- 2.2 Where do you live? How long have you lived there?

3. Behaviour

- 3.1 How often do you use public transport in the region?
- 3.2 What types of public transport do you typically use? (e.g., buses or trains)

[If only trains, ask why]

- 3.3 What are your usual destinations when using public transport? (e.g., work, school, shop)

- 3.4 When using public transport, do you travel alone or with others?

[If with others, ask with who]

4. Motivation

- 4.1 For these journeys, what is your reason for choosing public transport over other forms of transportation?

- 4.2 What could be specific reasons why you might choose not want to use public transport?

5. Perception

- 5.1 What is your overall opinion of public transport in the region?

[Ask further, what contributes to this opinion]

- 5.2 How do you think public transport in your area compares to other places you've been?

[Ask further, why do they think this]

6. Challenges

- 6.1 Have you encountered any issues or challenges while using public transport?

[Ask further, how did they deal with these issues or challenges]

- 6.2 What do you find most difficult about using public transport in this region?

[Ask further, why is that]

7. Missing

- 7.1 Is there anything that you find to be currently missing from public transport here?

[Ask further, why are the missing this]

- 7.2 What changes would make you more likely to use public transport more often?

[Ask further, why would this make them want to use public transport more]

8. Closing Questions

- 8.1 Do you have any additional comments or suggestions about public transport, or anything else?

Concluding Remarks

"Thank you very much for sharing your insights and taking the time to speak with me today. Your input is very valuable to this research, and I greatly appreciate your participation.

I once again would like to reiterate that all information you provided today will be kept confidential.

If you have any additional questions, or would like to reach me for another reason, feel free to contact me through my email

Appendix H. Interview informed consent sheet

Onderzoek naar de ervaringen, meningen en behoeften van gebruikers van het openbaar vervoer in Noord-Holland Noord

U wordt uitgenodigd om deel te nemen aan een onderzoek genaamd "Ervaringen van gebruikers van het openbaar vervoer in Noord-Holland Noord". Dit onderzoek wordt uitgevoerd door Dani Boon van de TU Delft, in samenwerking met Provincie Noord-Holland.

Het doel van dit onderzoek is om een inzicht te creëren in de ervaring, meningen en behoeften van de reizigers die wel, én niet gebruik maken van het openbaar vervoer in Noord-Holland Noord en zal ongeveer 20 tot 40 minuten in beslag nemen. De data zal gebruikt worden binnen de context van een afstudeer proefschrift. U wordt gevraagd om uw ervaringen met het openbaar vervoer te delen, en een gesprek aan te gaan omtrent het openbaar vervoer.

Zoals bij elke online activiteit is het risico van een databreuk aanwezig. Wij doen ons best om uw antwoorden vertrouwelijk te houden. We minimaliseren de risico's door geen vertrouwelijke of identificeerbare data te verzamelen, en bij het verwerken van de data deze te anonimiseren. Na afloop van het project zal ook de ruwe data verwijderd worden.

Uw deelname aan dit onderzoek is volledig vrijwillig, en u kunt zich elk moment terugtrekken zonder reden op te geven. U bent vrij om vragen niet te beantwoorden.

Contactgegevens onderzoeker:
Dani Boon

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. Ik heb de informatie over het onderzoek gedateerd 4 april 2024 gelezen en begrepen, of deze is aan mij voorgelezen. Ik heb de mogelijkheid gehad om vragen te stellen over het onderzoek en mijn vragen zijn naar tevredenheid beantwoord.	<input type="checkbox"/>	<input type="checkbox"/>
2. Ik doe vrijwillig mee aan dit onderzoek, en ik begrijp dat ik kan weigeren vragen te beantwoorden en mij op elk moment kan terugtrekken uit de studie, zonder een reden op te hoeven geven.	<input type="checkbox"/>	<input type="checkbox"/>
3. Ik begrijp dat mijn deelname aan het onderzoek de volgende punten betekent. Het gesprek kan worden opgenomen, indien u hiermee instemt. <ul style="list-style-type: none">Deze opname zal uitgeschreven worden, waarna de opname verwijderd zal worden.Er kunnen geschreven notities gemaakt worden van het gesprek.	<input type="checkbox"/>	<input type="checkbox"/>
4. Ik begrijp dat er voor mijn deelname aan het onderzoek geen gecompenseerd geldt.	<input type="checkbox"/>	<input type="checkbox"/>
5. Ik begrijp dat de studie, en het verzamelen van data na het gesprek eindigt.	<input type="checkbox"/>	<input type="checkbox"/>
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. Ik begrijp dat mijn deelname de volgende risico's met zich meebrengt omtrent data en privacy. Ik begrijp dat deze risico's worden geminimaliseerd door de data te anonimiseren voor gebruik, en door het secuur opslaan van de ruwe data.	<input type="checkbox"/>	<input type="checkbox"/>
7. Ik begrijp dat mijn deelname betekent dat er persoonlijke identificeerbare informatie en onderzoeksdata worden verzameld, met het risico dat ik hieruit geïdentificeerd kan worden.	<input type="checkbox"/>	<input type="checkbox"/>
8. Ik begrijp dat de volgende stappen worden ondernomen om het risico van een databreuk te minimaliseren, en dat mijn identiteit op de volgende manieren wordt beschermd in het geval van een databreuk. <ul style="list-style-type: none">Ruwe data wordt secuur opgeslagen door de TUDelft.Na afloop van het project wordt de ruwe data verwijderd.De data wordt geanonimiseerd voor gebruik.	<input type="checkbox"/>	<input type="checkbox"/>
9. Ik begrijp dat de persoonlijke informatie die over mij verzameld wordt en mij kan identificeren, zoals naam, leeftijd, geslacht, niet gedeeld worden buiten het studieteam.	<input type="checkbox"/>	<input type="checkbox"/>
10. Ik begrijp dat de persoonlijke data die over mij verzameld wordt, vernietigd wordt na afloop van het project, geschat op 15 oktober 2024.	<input type="checkbox"/>	<input type="checkbox"/>
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
11. Ik begrijp dat na het onderzoek de verwerkte en geanonimiseerde informatie gebruikt zal worden voor het proefschrift, wat gepubliceerd zal worden naar de TUDelft Education Repository.	<input type="checkbox"/>	<input type="checkbox"/>
12. Ik geef toestemming om mijn antwoorden, ideeën of andere bijdrages anoniem te quoten in resulterende producten.	<input type="checkbox"/>	<input type="checkbox"/>

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
13. Ik geef toestemming om de geanonimiseerde data, verkregen uit het gesprek, die over mij verzameld worden gearhiveerd worden in TU Delft Education Repository opdat deze gebruikt kunnen worden voor toekomstig onderzoek en onderwijs.	<input type="checkbox"/>	<input type="checkbox"/>
14. Ik begrijp dat de toegang tot deze repository open is.	<input type="checkbox"/>	<input type="checkbox"/>

Signatures

Naam deelnemer Handtekening Datum

Ik, **de onderzoeker**, verklaar dat ik de informatie en het instemmingsformulier correct aan de potentiële deelnemer heb voorgelezen en, naar het beste van mijn vermogen, heb verzekerd dat de deelnemer begrijpt waar hij/zij vrijwillig mee instemt.

Naam onderzoeker Handtekening Datum

Contactgegevens van de onderzoeker voor verdere informatie:

Dani Boon

Appendix I. Expanded personas

Emma

Emma represents the students, who commute to school on a daily basis, but also often travel to visit their friends. They rely primarily on personal transport like their bikes for the freedom and autonomy it offers, but occasionally use public transport to get around when it is more convenient, or when circumstances leave little choice.

Motivation:

- Wants to travel for friends, has to travel for school

Situation:

- Lives in Ursem (with her parents)

Occupation:

- Student in Alkmaar

Traits:

- Relies on bike and public transport (mostly bus) to get around
- Bikes as default, but circumstances may make her choose for public transport instead
- Has friends in neighbouring villages
- Has limited financial freedom

Behaviours:

- Does not like to bike in the rain, at night, or too far
- Considers effort and financial cost when choosing method of travel
- Values comfort in her journey
- Values efficiency in her journey
- Often travels alone

Needs:

- Community
- Autonomy
- Comfort
- Security

Struggles:

- Has to travel far to reach friends and school
- Wants to be able to dictate her own schedule
- Bus can be unreliable at times
- Is forced to plan around the limited schedule of the bus



Femke

Femke represents the office workers who commute to the company office when they want to work on site. With more freedom to plan their journeys around their schedules, as well as more freedom in means of travel, they often weigh their options based on comfort, efficiency and potential benefits it offers.

Motivation:

- Has to travel for work and want to do so efficiently and comfortably

Situation:

- Lives in Tuitjenhorn (with husband and kids)

Occupation:

- Works a full-time office job in Hoorn

Traits:

- Relies on public transport and car to travel
- Mostly travels by car, but often uses public transport to travel to work
- Has financial freedom

Behaviours:

- Plans when to travel to fit with work schedule
- Uses travel time to work
- Avoids traveling in rush hour
- Seeks out rest when traveling
- Given the same travel time, prefers to travel by public transport

Needs:

- Competence
- Comfort
- Fitness
- Purpose

Struggles:

- Has to manage with the uncertainties of public transport
- Wants to be able to travel efficiently and comfortably
- Traveling with public transport requires more effort
- Despite its benefits, public transport still isn't the clearly better option



Martin

Martin represents the manual labourers who commute to their job sites on a daily basis. Their set schedules often limit their freedom when travelling, and they value comfort and efficiency to make the transition from work to private life as smooth as possible.

Motivation:

- Has to travel to different worksites, and wants to do so quickly

Situation:

- Lives in Wieringerwaard (with wife)

Occupation:

- Works a full-time construction job at various locations

Traits:

- Relies almost exclusively on car to travel
- Works long days, and starts early
- Likes to travel efficiently, without wasting time
- Has decent financial freedom

Behaviours:

- Travel by car to wherever he is working at that time
- Pick up some colleagues for carpooling on the way to work
- Has a close bond to his colleagues
- Is very aware of his health
- Has flexible working hours
- Has flexible working locations

Needs:

- Competence
- Autonomy
- Fitness
- Comfort

Struggles:

- Cannot work when travelling, only on location
- Destinations are difficult to efficiently reach without car
- Has to bring tools to work
- Work puts a large physical strain on his body



Klaas

Klaas represents the retirees who no longer have a regular commute. Unable or unwilling to rely on personal transport, instead they rely on public transport to travel around. When travelling, they value the freedom, comfort and flexibility afforded by public transport.

Motivation:

- Wants to travel for fun, and to visit friends

Situation:

- Lives in Hem (alone)

Occupation:

- Retired

Traits:

- Does not have a car anymore
- Is physically weakening due to old age
- Has a small, but close social circle in the area
- Has decent financial freedom

Behaviours:

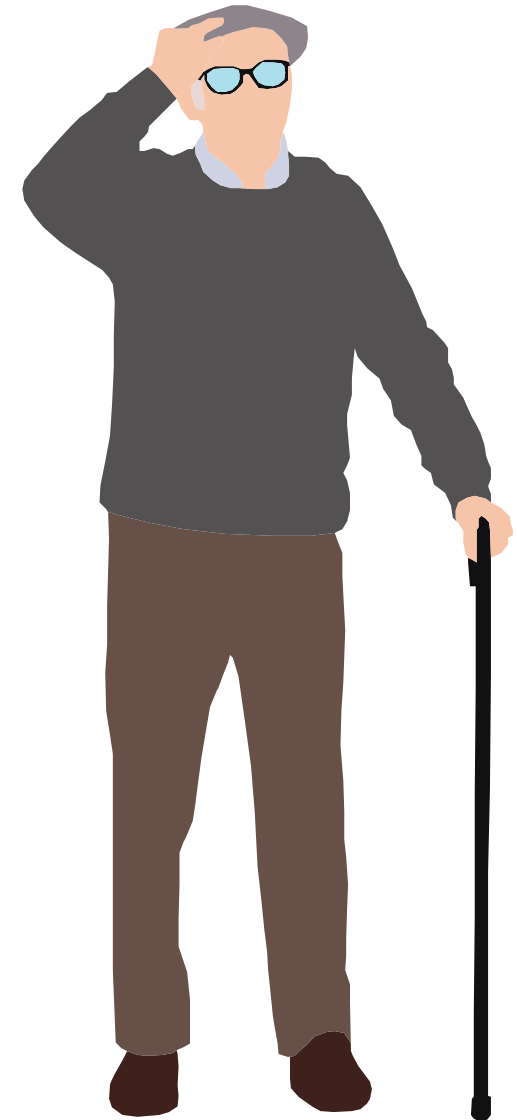
- Travels without being bound by time or routes
- Enjoys traveling by public transport for the freedom, the comfort and the sights
- Want to get out to maintain physical health
- Carefully plans his journeys ahead of time
- Is flexible when unexpected changes arise

Needs:

- Comfort
- Beauty
- Relatedness
- Fitness

Struggles:

- Can no longer drive a car, or walk and bike for longer distances
- His social circle is getting smaller and harder to reach
- Sometimes has trouble keeping up with the times, and may require some guidance



Richard

Richard represents the voluntary bus drivers. While not a traditional traveller, they are still key users of the buses. As volunteers, they are driven by their desire to support and give to their own communities, often going beyond what is asked of them.

Motivation:

- Wants to help 'his' people be more mobile

Situation:

- Lives in Anna Paulowna (with his wife)

Occupation:

- Retired, voluntary bus driver

Traits:

- Volunteers for driving the community bus several times a month
- Knows a lot of people from the region
- Is still physically well

Behaviours:

- Is socially active towards his passengers
- Wants to give to his community by driving the bus
- Feels responsible for the journey of his passengers

Needs:

- Impact
- Morality
- Purpose
- Recognition

Struggles:

- Wants to help more people, but is limited by the bus
- Does not want to drive around uselessly
- Can't be there for everyone



Appendix J. Context factors

Factor Number	Short description	DEPEST	Type
1	Level of loneliness has increased in the last 43 years (Kara-Yakoubian, 2022)	Demographic	Development
2	Children own digital devices from a lower(ing) age (Generation Alpha will lead a 100% digital world, 2021)	Demographic	Trend
3	World population will continue to grow to 9.73 billion (Vollset, 2020)	Demographic	State
4	US adults who use social media increased from 5% (2005) to 79% (2019) (Ortiz-Ospina, 2019)	Demographic	Development
5	Two-thirds of all internet users use social media sites (Ortiz-Ospina, 2019)	Demographic	State
6	The working week will get shorter (Burchell et al., 2024)	Demographic	Development
7	Generation Alpha will take environmental consciousness in brand for granted (Rogalski, z.d.)	Demographic	State
8	'Families' become more complex (Sedee, 2022)	Demographic	Development
9	The next generation (Alpha) will lead a fully digital world (Generation Alpha will lead a 100% digital world, 2021)	Demographic	State

10	Nearly half of people in UK, US and China claim to do everything they can to live more sustainably (Willingness towards sustainable living 2021, 2022)	Ecological	State
11	We are heading towards a circular built environment (Hunziker & De Giovanetti, 2022)	Ecological	Development
12	Car sharing helps reducing local air pollution (Richie, 2020)	Ecological	Principle
13	Public transport has a lower carbon footprint than private transport (Richie, 2020)	Ecological	State
14	Transport accounts for 20% of global CO2 emissions (Richie, 2020)	Ecological	State
15	Millennials are much more likely than baby boomers to change habits for a lesser environmental impact (Was 2018 the year of the influential sustainable consumer?, 2018)	Ecological	State
16	Global population over 65 is growing the fastest (United Nations, z.d.)	Demographic	Development
17	The line between public transit, and mobility services is blurring (Amblard, 2018)	Political	Trend

18	A special drivers licence for autonomous vehicles is being considered by some states (Autonomous Vehicles Self-Driving Vehicles Enacted Legislation, z.d.)	Political	Principle
19	The predominant customers of future vehicles will be municipalities and transport associations (Self-driving vehicles are becoming a means of public transport, 2021)	Political	Development
20	Emergence of office hubs bring work closer to home (Rijkswaterstaat, DDW 2022)	Economic	Development
21	Previously unpaid domestic work is marketized (Manyika et al., 2017)	Economic	Trend
22	Working remotely is increasing after the pandemic (Manyika et al., 2021)	Economic	Trend
23	EV sales have more than doubled in 2021 dan continue to rise (World Energy Investment 2022, 2022)	Economic	Trend
24	Companies familiar with disruption in the automotive sector have an advantage (Bardt, 2017)	Economic	Trend
25	There are too many cars on the roads (Rijkswaterstaat, DDW 2022)	Economic	State

26	Further automation could replace more jobs in the future (Manyika, 2017)	Economic	Development
27	Generation alpha experiences anger and fear due to climate crisis stress (Vis, 2022)	Socio-cultural	Development
28	Family togetherness is a national ideal (Genders et al., 2016)	Socio-cultural	Principle
29	Everyone will have their own truth (Outeren, 2022)	Socio-cultural	Trend
30	Qualifications of 'elite' shift from watches and fancy suits to oat milk and yoga (Kooymann, 2019)	Socio-cultural	Trend
31	Young adults feel the need for a digital detox (Boon, 2019)	Socio-cultural	Trend
32	The automotive future is shared (de Jong, 2019)	Technological	Development
33	The automotive future is autonomous (de Jong, 2019)	Technological	Development
34	EV platforms are becoming the standard (Torchinsky, 2021)	Technological	Trend
35	It's easier to get private vehicle owners to some other mode of transport than to public transport (Ploeger, 1994)	Socio-cultural	Principle
36	10% of vehicles across the world will be used for mobility services by 2030 (FEV Marketing, 2019)	Political	Principle

37	Ageism plays a role the the ethics of autonomous vehicles (Gerders et al., 2016)	Socio-cultural	State
38	Autonomous vehicles are safer than human driven vehicles (Watney, 2018)	Technological	Principle
39	The automotive future is connected (de Jong, 2018)	Technological	Development
40	Levels of autonomous driving will increase (FEV, 2021)	Technological	Trend
41	EV design is becoming its own thing, rather than being ICE cars with a battery (Torchinsky, 2021)	Technological	Development
42	The future of UX will rely on touch, voice and gesture control (In defence of big screens: Merc UX design boss fights back, 2022)	Technological	Trend
43	Automotive industry shifts towards modular vehicle bodies (Pandremenos et al., 2009)	Technological	Development
44	In 2015, not even the most advanced self driving cars could detect small animals	Technological	Principle
45	The automotive future is electrified (de Jong, 2019)	Technological	Development
46	New (vehicle) innovations are successful when they are Most Advance, Yet Acceptable (TU Delft)	Socio-cultural	Principle
	Vehicle interiors are expected		

47	Vehicle interiors are expected to become more important than the exterior (McKinsey: The future of interior in automotive, 2021)	Technological	Development
48	Trucks and parcel delivery vehicles will be the first to automate (Bertoncello & Wee, 2021)	Technological	Trend
49	An electric vehicle has a different character than a vehicle with an ICE (Volkswagen: Sound Design, 2019)	Technological	State
50	Drivers are overwhelmed by their cars features (Lumley, 2023)	Technological	Trend
51	Humans want to be mobile (Lightyear, 2022)	Socio-cultural	State
52	More cities are becoming car free (Moldovan, z.d.)	Political	Development
53	Future mobility is software defined (Boisseau, 2023)	Technological	Development
54	Global increase in individualism (Santos et al., 2017)	Socio-cultural	Trend
55	More people move away from the Randstad than move to the Randstad (CBS, 2022)	Demographic	Development
56	Young adults move to the city, while people above 30 leave the city (Husby et al., 2019)	Demographic	Development
	Working remotely results is		

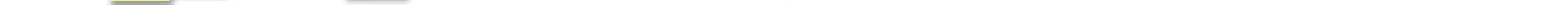
57	Working remotely results in less congestion (Buitelaar et al., 2021)	Economic	Trend
58	Working remotely changes how the offices are and function (Buitelaar et al., 2021)	Political	Development
59	More 'megacities' will arise	Economic	Development
60	The cost of car ownership is rising (Thomas, 2023)	Economic	Development
61	The better public transport is, the lower car ownership levels are (Mulalic & Rouwendal, 2020)	Political	Principle
62	Car ownership levels are increasing (Zijlstra et al., 2022)	Socio-cultural	Trend
63	Car dependency outside of the city is growing (Zijlstra et al., 2022)	Socio-cultural	Trend
64	Shift to higher level automation is taking longer than expected (Chiao, 2024)	Technological	Development
65	There is a remote work revolution coming (Hogan, 2024)	Socio-cultural	Trend
66	Hybrid working is becoming the norm (Hogan, 2024)	Socio-cultural	Trend
67	Rise in working flexible hours (CIPD, 2022)	Economic	Development
68	Job engagement in both full-time in-office and full-time remote work has dropped (McGregor, 2024)	Demographic	Trend

69	Four day workweeks are here to stay (McGregor, 2024)	Economic	Development
70	Global staff shortages continue to rise (Buchholz, 2024)	Economic	Development
71	Push for education to focus on helping individual fulfil their potential (OECD, 2018)	Political	Development
72	Push for student agency in education (OECD, 2018)	Political	Development
73	Focus on mental health will be natural in the future (Trommels, z.d.)	Socio-cultural	Trend
74	Dutch population continues to age, with a projected 25% of the population being elderly in 2040 (CBS, 2022)	Demographic	Development
75	Rate of ageing is higher outside of city (CBS, 2022)	Demographic	Development
76	The individual is the buildingblock of the society (Kniesmeijer, 2018)	Socio-cultural	Principle
77	One buildingblock amounts to nothing, by connecting with others we can build something more (Kniesmeijer, 2018)	Socio-cultural	Principle
78	More and more people are doing volunteer work (CBS, 2024)	Socio-cultural	Trend
	Financial and emotional well-being of young adults is trailing behind other age groups (CBS,		

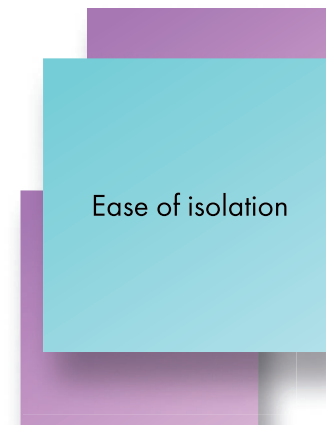
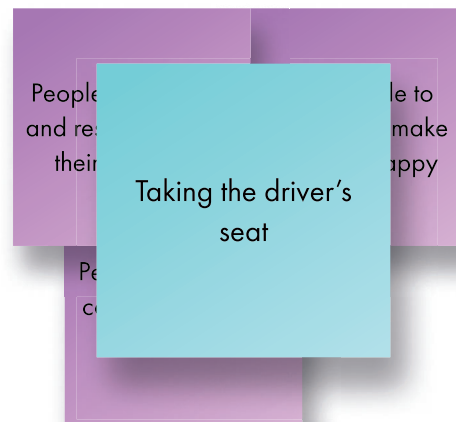
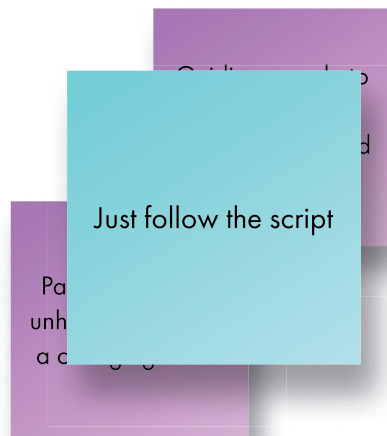
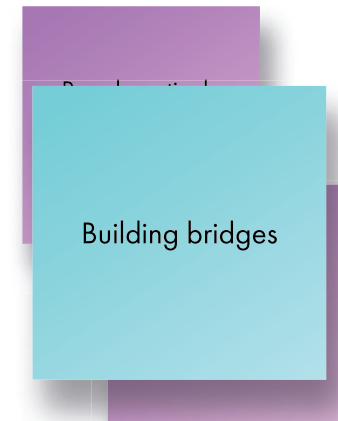
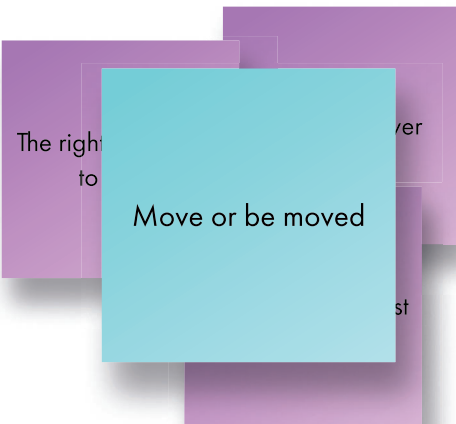
79	Financial and emotional well-being of young adults is trailing behind other age groups (CBS, 2024)	Demographic	Development
80	The rich and poor live in different social environments (Vermelj & Thijssen, 2024)	Socio-cultural	Trend
81	Social environments inside the city are more one-sided than outside the city (Vermelj & Thijssen, 2024)	Socio-cultural	Principle
82	People who need support from the social domain are not always reached in time (Plaisier et al., 2023)	Socio-cultural	Principle
83	People want to be seen, heard and helped (Plaisier et al. 2023)	Socio-cultural	Principle
84	Lower social cohesion leads to lower satisfaction with life (CBS, 2018)	Socio-cultural	Principle
85	More people experience a shortage of social cohesion (de Bakker et al., 2023)	Socio-cultural	Principle
86	Dutch population feels uneasy about the future of the Netherlands (Geurkink & Miltenburg, 2023)	Socio-cultural	Development
87	People in non-urban areas feel more uneasiness than those in urban areas (Geurkink & Miltenburg, 2023)	Socio-cultural	Development
	Dutch government lowers		

88	Dutch government lowers investments in public transport	Political	Development
89	Hubs will be the key in the mobility transition (Goudappel, z.d.)	Technological	Development
90	Demand responsive transport could disrupt the transportation sector (Schlüter et al., 2021)	Technological	Development
91	People are growing less patient than in the past (Anderer, 2019)	Socio-cultural	Trend
92	The percentage of people who have a drivers licence is staying the same (CBS, 2024)	Demographic	Trend
93	Percentage of elderly who have a drivers licence is rising (CBS, 2024)	Demographic	Trend
94	Percentage of young adults who have a drivers licence is dropping (CBS, 2024)	Demographic	Trend
95	Physical relationships are not fundamental in the technological future (Bastiani, 2023)	Socio-cultural	Trend
96	People value consistency and routines (Smith, 2020)	Socio-cultural	Principle
97	People do not cope well with uncertainty (Smith, 2020)	Socio-cultural	Principle
98	In the future, people will rent more instead of owning products (Steward et al., 2023)	Political	Development

99	(Product) ownership will still provide happiness in the future (Steward et al., 2023)	Socio-cultural	Development
100	Travellers want their vehicles to suit their needs (Rogalski, z.d.)	Demographic	Trend
101	Future travellers are excited about new options to travel (Heineke et al., 2023)	Technological	Trend
102	In the future, all the cables in the ground will make it difficult for green to take root (DDW, 2022)	Ecological	Development
103	Satisfaction of public transport users increases every year (OV-Magazine, 2015)	Demographic	Trend
104	The image of public transport among non-users is bad (OV-Magazine, 2015)	Demographic	Trend
105	Younger generation value a good job over a well-paying job (Klenter, 2022)	Demographic	Trend
106	The amount of people who think work is a "very important" part of their life drops from 60% in 1990 to 24% (Depeursinge, 2022)	Demographic	Trend
107	Workers view work-life balance as more important than pay (Reuters, 2024)	Demographic	Trend
108	By 2050 7 out of 10 people will live in the city (Buss et al., 2020)	Demographic	Trend







Appendix L. Expanded future profiles

Expected student

Motivation:

- Wants to have maximum convenience in life and travel

Situation:

- Lives in Ursem (with her parents)

Occupation:

- Student in Alkmaar

Traits:

- Almost exclusively relies on public transport to travel
- Has many acquaintances, but no close friends
- Has little freedom of choice in travel means

Behaviours:

- Likes to be guided/steered throughout her entire day
- Values convenience above all
- Wants to leave the thinking to AI
- Prefers to take a passive role in travelling

Needs:

- Comfort
- Community
- Security
- Stimulation

Struggles:

- Further away from the city, the public transport is less good, requiring her to sometimes take a more active roll
- Ease of passivity can easily turn into a feeling of powerlessness



Desired student

Motivation:

- Wants to carve her own path through life

Situation:

- Lives in Ursem (with her parents)

Occupation:

- Student in Alkmaar

Traits:

- Mostly relies on public transport to travel, but sometimes chooses to go by bike instead
- Has a small circle of close friends
- Has little freedom of choice in travel means

Behaviours:

- Lets no-one dictate her life for her
- Actively tries to communicate and connect with the people around her
- Considers which routes to travel to reach her destination

Needs:

- Autonomy
- Relatedness
- Impact
- Beauty

Struggles:

- It is easy and comfortable to let others manage your life for you, but giving away control is a slippery slope
- The world is moving to more and more automation, to fight it is a uphill battle

Expected worker

Motivation:

- Wants to work as efficiently as possible, wherever she is

Situation:

- Lives in Tuitjenhorn (with husband and kids)

Occupation:

- Works a full-time office job in Hoorn

Traits:

- Often times work fully occupies her mind, even 'outside of office hours'
- Has little social connections outside of colleagues and family.
- Has a lot of freedom to choose how to travel
- Exclusively uses public transport to travel to work

Behaviours:

- Wants to be able to work almost everywhere
- Works when travelling to or from work
- Leaves the planning of travel to AI so that she can continue working efficiently
- Isolates herself when travelling

Needs:

- Competence
- Impact
- Comfort
- Fitness

Struggles:

- Sometimes it is difficult to work when travelling, leading to 'lost time'
- Working this much, and at various location puts a large strain on her (mental) health



Desired worker

Motivation:

- Wants to create clear boundaries in life, and be more conscious of her life and surroundings

Situation:

- Lives in Tuitjenhorn (with husband and kids)

Occupation:

- Works a full-time office job in Hoorn

Traits:

- Often uses public transport to travel to work
- Has many social connections ranging in closeness
- Has a lot of freedom to choose how to travel
- Mostly uses public transport to travel to work

Behaviours:

- Only works at the office, and travels to be on time for it
- Enjoys the convenience of efficient public transport
- Spends travel time consciously observing her surroundings
- Likes to talk to other travellers
- Avoids the topic of work when not at work

Needs:

- Relatedness
- Beauty
- Fitness
- Stimulation

Struggles:

- Not working while travelling requires her to travel earlier in the morning, and later in the afternoon
- Not everyone feels the same way she does, so connecting with other travellers sometimes isn't possible

Expected laborer

Motivation:

- Wants to be as efficient as possible in working, and in reaching work

Situation:

- Lives in Wieringerwaard (with wife)

Occupation:

- Works a full-time construction job at various locations

Traits:

- Relies on public transport for travelling when possible
- Has limited social connections with his colleagues
- Has limited freedom when choosing when and how to travel to work

Behaviours:

- Doesn't bother connecting with his current colleagues as he'll might be working with different colleagues tomorrow
- Retrieves the needed tools at the worksite
- Does exactly as his briefing tells him

Needs:

- Purpose
- Comfort
- Stimulation
- Fitness

Struggles:

- Work can feel like a drag, with a changing roster of colleagues, he has difficulty to connect with any of them
- Sometimes neglects to take into account his own physical needs



Desired laborer

Motivation:

- Wants to manage himself and his health first, and his work second

Situation:

- Lives in Wieringerwaard (with wife)

Occupation:

- Works a full-time construction job at various locations

Traits:

- Relies on public transport and carpooling to travel to work
- Has many social connections ranging in closeness
- Has limited freedom when choosing how and when to travel to work

Behaviours:

- Actively negotiates his current working situation
- Tries to make small talk as often as possible to build connections with his colleagues
- Brings his own set of tools to work

Needs:

- Fitness
- Competence
- Community
- Comfort

Struggles:

- Sometimes feels conflicted when prioritizing his own health over his work
- Has to carry around his heavy packing of personal tools

Expected retiree

Motivation:

- Wants to have an easy existence, without having to deal with any obstacles

Situation:

- Lives in Hem (alone)

Occupation:

- Retired

Traits:

- Has difficulties keeping up with his increasingly complex surroundings
- Exclusively relies on public transport to travel around
- Has little close acquaintances left
- Has much freedom in choosing when and where to travel
- Doesn't often travel
- Would rather be visited by people than visit them himself

Behaviours:

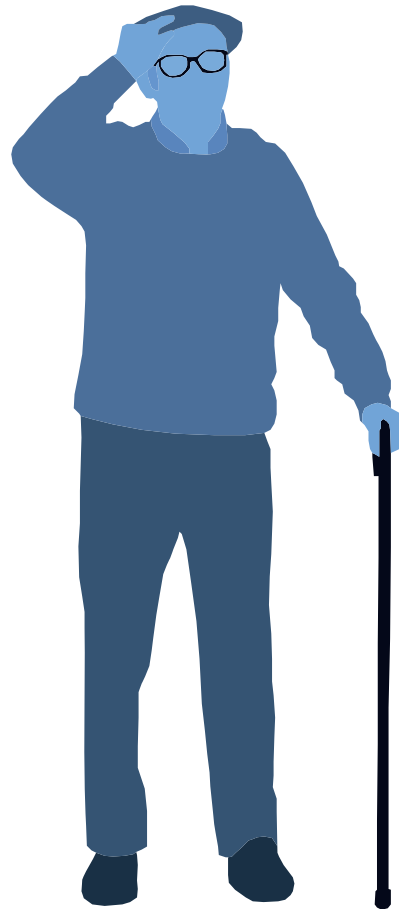
- Wants to be fully guided by his virtual assistant in when and where to go
- Feels overwhelmed quickly when outside
- Gets lost easily

Needs:

- Comfort
- Security
- Purpose
- Fitness

Struggles:

- Has difficulty filtering information based on what is useful to him
- Physical weakening has made moving around more difficult.



Desired retiree

Motivation:

- Wants to retain his control over his own life, health, and wellbeing

Situation:

- Lives in Hem (alone)

Occupation:

- Retired

Traits:

- Comes outside often
- Has a small circle of close acquaintances
- Mostly relies on public transport to travel around, only short distances are walked
- Has much freedom in choosing when and where to travel

Behaviours:

- Tries to strike up a conversation with anyone willing to join him
- Walks outside to preserve his physical wellbeing
- Enjoy being outside, seeing the world and talking to people

Needs:

- Community
- Fitness
- Beauty
- Impact

Struggles:

- Sometimes struggles to determine what is and isn't worth his time and energy
- Might have some difficulty in finding conversational partners in this busy world

Expected driver

Motivation:

- Wants to be a cog in a system meant to help the people around him

Situation:

- Lives in Anna Paulowna (with his wife)

Occupation:

- Retired, voluntary bus driver

Traits:

- Volunteers for driving the bus no more than is strictly necessary
- Tries to drive on quiet days
- Knows very little of the travellers
- Isn't dependant on public transport himself

Behaviours:

- Does not like to interact with the passengers boarding the bus
- Does exactly what he is told to do, and not more
- Prefers quiet and easy days and routes

Needs:

- Morality
- Comfort
- Purpose
- Competence

Struggles:

- Sometimes has difficulty in seeing the value of the voluntary work that he does
- The bus cannot drive itself for some part of the routes, forcing him to have to drive it manually



Desired driver

Motivation:

- Wants to do more to better and more pleasantly help the people around him

Situation:

- Lives in Anna Paulowna (with his wife)

Occupation:

- Retired, voluntary bus driver

Traits:

- Volunteers for driving the bus as often as is allowed or fun for him
- Drives on the busier and more challenging days
- Knows many of the regular travellers
- Isn't dependant on public transport himself

Behaviours:

- Greets every passenger boarding the bus
- Tries to make conversation with the passengers aboard
- Goes out of his way to better help his passengers
- Often takes over from autonomous driving to make the ride more comfortable for his passengers

Needs:

- Impact
- Relatedness
- Morality
- Purpose

Struggles:

- Is limited in how many people he can help throughout the day
- Sometimes is unable to make conversation with his passengers when driving needs more attention

© 2015 Pearson Education, Inc. or its affiliate(s). All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage or retrieval system, without prior written permission from the publisher.



