Accessibility for the elderly in the province of Groningen

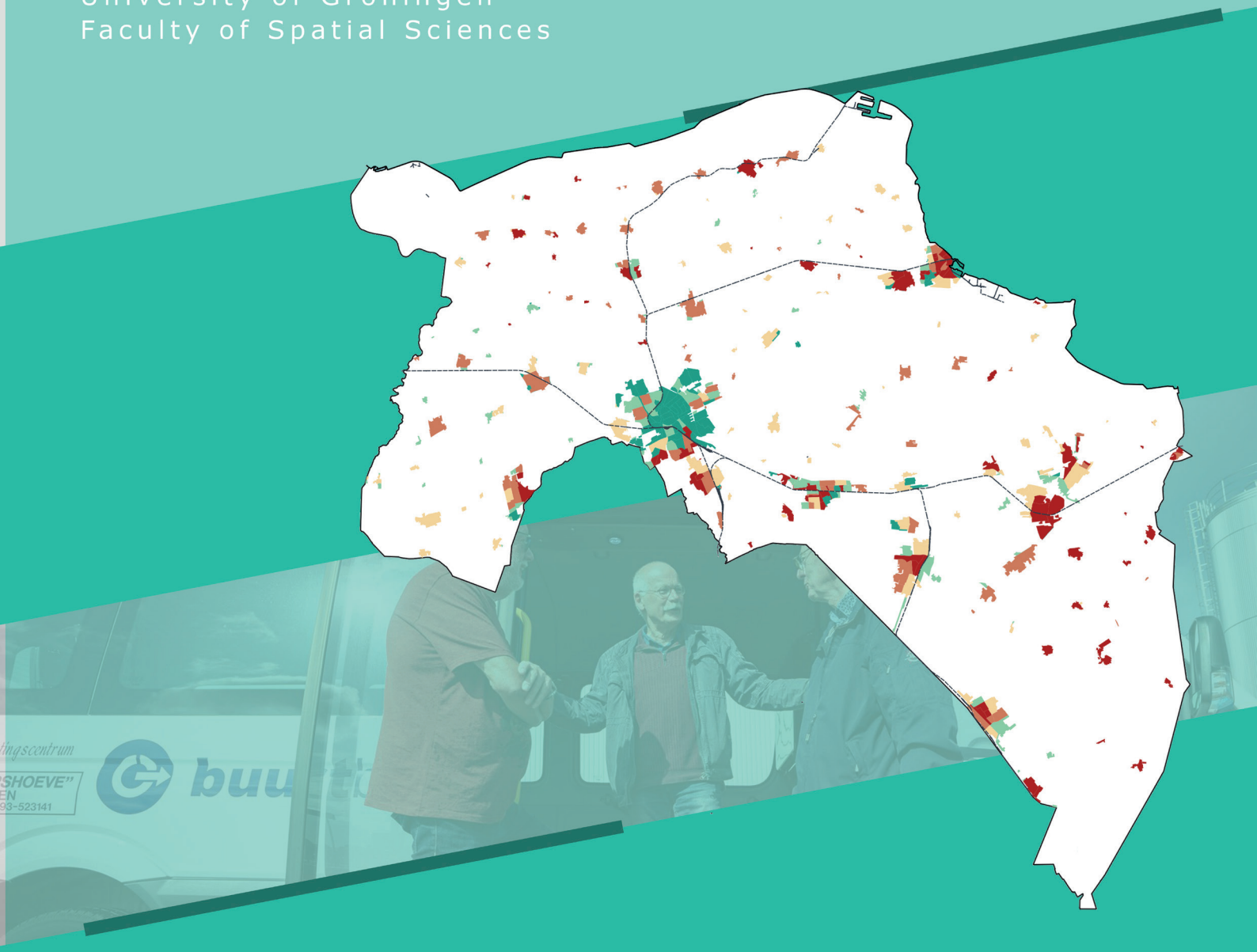
An advisory report on the accessibility for elderly, now and in the future

Peter Leliveld
S3381811

Master thesis | Environmental & Infrastructure Planning

Supervisor: Dr. Farzaneh Bahrami

University of Groningen
Faculty of Spatial Sciences



rijksuniversiteit groningen

JULY, 2022

Table of content

Preface

The main topic of this research concerns elderly and their contribution to society. During the COVID-19 pandemic, we have all seen the consequences of elderly being increasingly lonely. This is becoming an increasingly relevant problem as ageing in the Netherlands continues in the upcoming decades. This thesis researched what is needed in terms of accessibility in the province of Groningen to keep elderly participating in tomorrow's society.

This topic interests me personally as I see elderly around me being increasingly lonely. Moreover, as a spatial planner, I am interested in how mobility can help to keep elderly participating. I have studied Spatial Planning and Design in Groningen, and I am finishing my master focused on Environmental and Infrastructure Planning. This research thus combines knowledge of infrastructure and spatial planning and personal interest in the participation of elderly. Besides my study, I am working as a researcher focussing on the housing market. Having worked on several projects in the periphery of the province of Groningen, I got intrigued by the ageing the east of the province is experiencing. Additionally, the region is shrinking in population size, which makes the upkeep of public transport services challenging with a result of decreasing accessibility in general. It also decreases the foundation for services and facilities such as supermarkets. My experiences in my professional career helped me to become a better researched and made me better at spatial analysis. Secondly, it created an atmosphere around me where I frequently face the wishes of elderly regarding housing and the need to live nearby services or a bus stop. Finally, because I have researched this region from a demographic perspective in my work, I have a better understanding of the differences between municipalities, the city of Groningen, and the rest of the province.

With this research I hope to contribute to creating a better mobility system for elderly. The goal is to make it easier for elderly to participate in society and not see travelling as a burden. The thesis has been written for municipalities, the province of Groningen, Publiek Vervoer, public transport organisations, and parties involved in the mobility network's functioning in the province of Groningen.

During the writing process of this thesis, I learned more about the complexity of mobility for elderly. Each interview gave me a better view of the system's functioning and the problems that could occur in the future, which helped me better focus on my interviews and go deeper into the problems after each interview. I am delighted with the quality of the interviews and the variety of parties that contributed to this interview. I want to thank the interviewees for participating in this research and elaborate on this thesis' topic from their point of view. Secondly, I would like to thank Farzaneh Bahrami for supervising this thesis with much enthusiasm about the subject. Finally, I would like to thank my colleagues at KAW Architecten for giving me the support to finish my thesis and Hannah Habekotté for providing extra feedback.

Abstract

The north of the Netherlands is facing an increasingly ageing population. The ageing population often lives in rural areas with a lower population density. The low density areas challenges the current mobility services in the province of Groningen. The province of Groningen is an interesting case study as it has a large dense city with a relatively young population, and an ageing rural population. Good accessibility is essential for elderly as it contributes to healthy ageing. Healthy ageing is conceptualised in this research by using the Active Ageing Index (AAI). Two indicators of the AAI, Independent Living and Social Connectedness, are essential for elderly as they contribute to decreased loneliness and help to remain elderly more independent until older age. The proximity of services and bus stops influence how tempted elderly will be to use public transport. If the barrier to using public transport is too high, elderly will be more dependent on demand-responsive transport (DRT).

This research used both quantitative and qualitative data to answer the research question: What is needed in terms of accessibility in the province of Groningen to keep elderly participating in tomorrow's society? The economic stability of DRT will become more difficult in the future as the amount of elderly in need of DRT will grow due to the province's ageing. Public transport is ten times more affordable per kilometre than DRT, as DRT picks up elderly at home on demand and brings them to the requested location nearby. The economic stability of the DRT is thus crucial for the accessibility of elderly. In this research, spatial maps have been used to gain insights into areas with high shares of elderly and large distances to bus stops and facilities. These areas are thus more dependent on DRT to bring elderly to facilities and other destinations. By interviewing different parties with different views on this topic, the thesis aimed to get a holistic overview of the situation. Interview results have indicated a few different reasons why elderly sometimes have difficulties using public transport. Elderly in the province of Groningen are often afraid to use public transport as many things can go wrong, which creates anxiety. Secondly, elderly often cannot use a smartphone to find trip information. The confidence of elderly needs to be boosted if they want to use public transport. Boosting confidence could be done by training elderly and supplying more information about the use of public transport. This research' spatial analysis showed that many areas have a high share of elderly and have large distances to bus stops. The travel demand of elderly could be reduced by better spatial planning such as living closer to facilities and bus stops which would reduce the need to use DRT. Elderly use DRT as they have a Wmo-indication. This research showed that there is a large variety between municipalities in indicating elderly as in need of a Wmo-pass. Some municipalities are thus giving elderly a Wmo-pass more easily than others, and giving away an indication results in a higher amount of elderly with an economic incentive to use DRT. Making Wmo-consultants better aware of the costs of DRT and educating elderly about the functioning of public transport could help to reduce the demand for DRT. Clever apps could help to integrate all forms of transport better and thus make travelling easier for elderly. Stimulating elderly of tomorrow to use apps will help in the future to make travelling easier for them. This research, in the end, concluded that although the network in the province of Groningen is close-knit, much needs to be done still to keep the network economically stability. Economic stability of the network is needed to keep elderly included in tomorrow's society and reduce loneliness.

Dutch translation

Het noorden van Nederland wordt geconfronteerd met een steeds ouder wordende bevolking. De vergrijzende bevolking woont vaak in landelijke gebieden met een lagere bevolkingsdichtheid. De lage bevolkingsdichtheid stelt de huidige mobiliteitsdiensten in de provincie Groningen op de proef. De provincie Groningen is een interessante casestudy omdat zij een grote dichtbevolkte stad heeft met een relatief jonge bevolking, en een vergrijzende plattelandsbevolking. Goede bereikbaarheid is essentieel voor ouderen omdat het bijdraagt aan gezond ouder worden. Healthy ageing wordt in dit onderzoek geconceptualiseerd aan de hand van de Active Ageing Index (AAI). Twee indicatoren van de AAI, zelfstandig wonen en sociale verbondenheid, zijn essentieel voor ouderen omdat ze bijdragen aan minder eenzaamheid en ouderen helpen tot op hoge leeftijd onafhankelijker te blijven. De nabijheid van diensten en bushaltes beïnvloedt hoe geneigd ouderen zullen zijn om het openbaar vervoer te gebruiken. Als de drempel om het openbaar vervoer te gebruiken te hoog is, zullen ouderen afhankelijker zijn van vraagafhankelijk vervoer (DRT).

Dit onderzoek maakte gebruik van zowel kwantitatieve als kwalitatieve gegevens om de onderzoeksvraag te beantwoorden: Wat is er nodig op het gebied van bereikbaarheid in de provincie Groningen om te zorgen dat ouderen blijven deelnemen aan de samenleving van morgen? De economische stabiliteit van DRT zal in de toekomst moeilijker worden, omdat het aantal ouderen dat DRT nodig heeft door de vergrijzing van de provincie zal toenemen. Het openbaar vervoer is per kilometer tien keer zo betaalbaar als DRT, omdat DRT ouderen op afroep thuis ophaalt en naar de gevraagde locatie in de buurt brengt. De economische stabiliteit van de DRT is dus van cruciaal belang voor de bereikbaarheid van ouderen. In dit onderzoek zijn ruimtelijke kaarten gebruikt om inzicht te krijgen in gebieden met een hoog aandeel ouderen en grote afstanden tot bushaltes en voorzieningen. Deze gebieden zijn dus meer afhankelijk van de DRT om ouderen naar voorzieningen en andere bestemmingen te brengen. Door verschillende partijen met verschillende visies op dit onderwerp te interviewen, heeft dit onderzoek een holistisch beeld van de situatie gekregen. Uit de interviewresultaten zijn een paar verschillende redenen naar voren gekomen waarom ouderen soms moeite hebben met het gebruik van het openbaar vervoer. Ouderen in de provincie Groningen zijn vaak bang om gebruik te maken van het openbaar vervoer omdat er veel dingen mis kunnen gaan, wat angst oproept. Ten tweede kunnen ouderen vaak geen smartphone gebruiken om reisinformatie te vinden. Het vertrouwen van ouderen moet worden vergroot als zij gebruik willen maken van het openbaar vervoer. Het vergroten van het vertrouwen kan door ouderen te trainen en meer informatie te geven over het gebruik van het openbaar vervoer. Uit de ruimtelijke analyse van dit onderzoek bleek dat veel gebieden een hoog aandeel ouderen hebben en grote afstanden tot bushaltes. De reisbehoefte van ouderen zou kunnen worden verminderd door een betere ruimtelijke ordening, zoals dichter bij voorzieningen en bushaltes wonen, waardoor de noodzaak om DRT te gebruiken zou afnemen. Ouderen maken gebruik van DRT omdat zij een Wmo-indicatie hebben. Uit dit onderzoek is gebleken dat er een grote variatie is tussen gemeenten in het indiceren van ouderen die behoefte hebben aan een Wmo-pas. Sommige gemeenten geven ouderen dus makkelijker een Wmo-pas dan andere gemeenten, en het weggeven van een indicatie leidt tot een hoger aantal ouderen met een economische prikkel om gebruik te maken van DRT. Wmo-consulenten beter bewust maken van de kosten van DRT en

ze ouderen beter te laten voorlichten over de werking van het openbaar vervoer zou kunnen helpen om de vraag naar DRT te verminderen. Slimme apps zouden kunnen helpen om alle vormen van vervoer beter te integreren en zo het reizen voor ouderen makkelijker te maken. Ouderen van morgen stimuleren om apps te gebruiken zal in de toekomst helpen om het reizen voor hen makkelijker te maken. De conclusie van dit onderzoek is uiteindelijk dat het netwerk in de provincie Groningen weliswaar hecht is, maar dat er nog veel moet gebeuren om het netwerk economisch stabiel te houden. De economische stabiliteit van het netwerk is nodig om ouderen betrokken in de samenleving van morgen en eenzaamheid tegen te gaan.

Keywords: healthy ageing, accessibility, mobility, public transport, social connectedness, independent Living, life expectancy, demand-responsive transport, smart mobility.

Abbreviations:

AAI	**Active Ageing Index**
DALY	**Disability Adjusted Life Years**
DRA	**Dynamic response area**
DRT	**Demand-responsive transport**
FMTS	**Flexible micro transport services**
GIS	**Geographic Information System**
GP	**General practitioner**
Wmo	**Wet Maatschappelijke Ondersteuning | Social Support Act**

Introduction

Ageing in the Netherlands

Before explaining the relevancy of this thesis, it is helpful to give an overview first of how the Netherlands is ageing and what problems might arise in an ageing region. The share of elderly in the Netherlands rose from 12,8% in 1990 to 19,8% in 2020 (CBS, 2020), with both the share of 65+ and 80+ rising (figure 1). The rise in the share of elderly is partly due to the large birth surplus between 1945 and 1960 and better healthcare resulting in a longer life expectancy. Figure 2 shows that ageing has the most influence on municipalities in the periphery of the Netherlands. The ageing in this region is partially caused by youngsters migrating toward the western part of the Netherlands as there are more jobs and study opportunities. Especially the Northeastern part of the province of Groningen houses a relatively large share of elderly, whereas the city of Groningen is relatively young. This is a result from the many students living in the city as it houses large schools and universities. Moreover, the fertility rate decreases, which results in less children per household (Rijksoverheid, n.d. (a)). The decrease in the fertility rate is partially the result of young people leaving the periphery of the province (Elshof, 2017). Young people are leaving regions as there are less jobs due to decreasing investments in the area (Haatsen and Venhorst, 2010), resulting in a decreasing labour force (Delfmann et al., 2014). The amount of families living in the province of Groningen (excluding the municipality of Groningen), has been shrinking for at least the last eight years (CBS Statline, 2021 (d)). Figure 3 shows that the percentage of births per year per family decreased over the past eight years (CBS Statline, 2021 (e)), just as the amount of families living in the region (figure 4). The number of families in the province of Groningen (excluding the municipality of Groningen) decreased by approximately 0.8% while the number of births per year decreased by 0.9% per year (CBS Statline, 2021 (d); CBS Statline, 2021 (e)). During the same period (2013 till 2020) the number of singles increased by 1.2% per year. This is for a large part the result of an ageing population. The expectation was in 2015 that around 13.000 houses would be empty in the upcoming 25 years due to population shrinkage (Province of Groningen, 2015). However, although the number of the inhabitants did decline, the number of households increased in the region

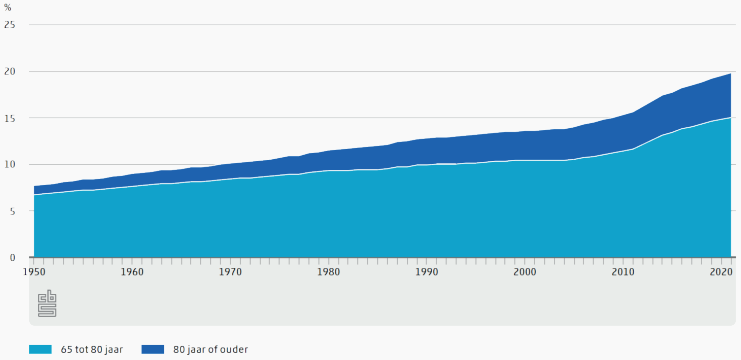


Figure 1: Double ageing in the Netherlands (CBS, 2020)

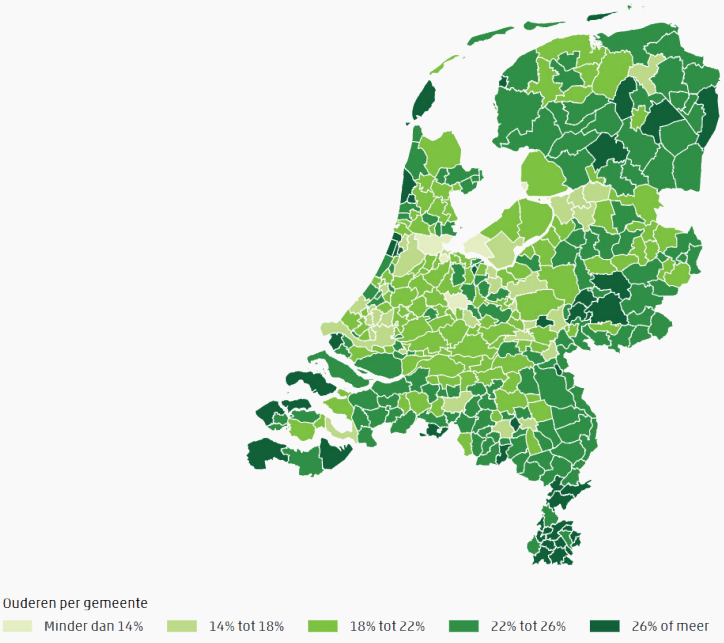


Figure 2: Share of elderly per municipality (CBS, 2020)

(CBS Statline (d). Nevertheless, especially in the parts with earthquake damage, the east of the province, more houses were demolished than built. The policy, focussed on the idea that the number of households would decrease, now creates a large shortage of houses in the region. Especially first-time home buyers have troubles finding a house in their own village (Heuff & Leliveld, 2022). This results in youngsters/ young families leaving the villages in the region to find a house elsewhere (De Stentor, 2022). The ageing of the province of Groningen is thus a result of two factors: young people leaving the region and start a family elsewhere, and the decreasing fertility rate.

According to CBS (2020), the Netherlands is facing a two-tier ageing process. Both the 65 to 80 and the 80+ age group are increasing in size. Not only is the Netherlands thus having more elderly, but their demand on the social systems is also growing. Generally, the health of the Dutch elderly is in good condition due to improved education and better lifestyles. Therefore, the number of frail elderly will be relatively more minor (De Jong et al., 2018). At the same time, elderly in the Netherlands prefer to live at home as long as possible. According to De Jong et al. (2018), "[…], six out of seven people aged 80 and older live at home; and the remainder (14%) lives in a nursing home. Of the total 80+ population, about one-third suffers from frailty through loss of function and reduced self reliance" (p. 102). According to the research, weak social networks are seen as one of the causes of reduced self-reliance. Within the group of frail elderly, elderly with low social-economic status and migrant backgrounds are overrepresented (De Jong et al., 2018). Elderly are, in this research, seen as people with an age of 65 and above. However, that does not mean that all elderly are seen as immobile. Therefore, this research also focusses on healthy life years and other forms of transport, such as cycling.

The old-age dependency ratio will increase and peak around 2040 (CBS, 2020). This means that planning for elderly will become more and more crucial. De Jong et al. (2018) state that "elderly-care is facing its greatest ever period of change" (p.102). The northern Netherlands is thus not only facing a group of elderly that is increasing in size, but they are also expected to be healthier and remain at home longer. This requires a rural system of services and accessibility that supports this growing group, as well as the group of elderly that is experiencing reduced self-reliance. This research will look at what change is needed in the province of Groningen to keep elderly participating in society and will advise on what could be improved.

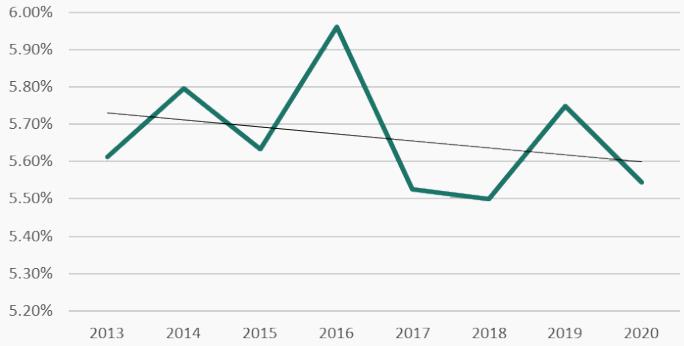


Figure 3: Percentage of births per year per family in the province of Groningen, without the municipality of Groningen (CBS Statline, 2021 (e)).

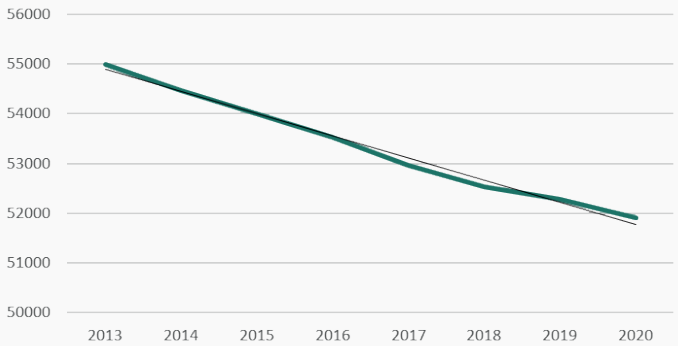


Figure 4: Number of families in the province of Groningen, without the municipality of Groningen (CBS Statline, 2021 (d)).

Relevance

The Netherlands is slowly ageing, with the northeast of the Netherlands as the most significant example. Not only is the north of Groningen dealing with ageing, it also has a negative migration deposit which mostly drains young people out of the region (Heuff & Leliveld, 2022). This trend, combined with a low fertility rate, will eventually lead to a relatively old population in the villages around the city of Groningen and a young population in the city itself. The differences in population density as well as having a region that has been experiencing population shrinkage makes the province of Groningen a valuable example to study the following research question; What is needed in terms of accessibility in the province of Groningen to keep elderly participating in tomorrow's society? Studying the province of Groningen as a case study will provide insights into how the different densities and shares of elderly affect the participation of elderly in today's and tomorrow's society. This research will look at the following sub-questions to answer the research question;

- What are the accessibility needs of elderly now and in the future?
- What are the current problems with transport for elderly?
- What are the initiatives that try and help elderly participate in today's and tomorrow's society?
- What are the main challenges ahead for public transport to serve elderly?

Keeping elderly included in today's society is essential as it could help against the increasing loneliness that elderly face. Moreover, it is important for the liveability of neighbourhoods and villages that elderly have the opportunity to go out. Elderly in the Netherlands are stimulated to live at home at old age as long as possible, which can be made possible by adjustments to the house and a decent service system that helps elderly to stay mobile and active. Ageing in their own environment is deemed to contribute to the highest quality of life possible. With the ageing population, especially in the northern Netherlands, it is important to research the mobility systems that help elderly stay active and undertake activities. The concept of accessibility has been chosen in this research as accessibility can be defined as the "[…] easiness to reach land-uses by means of available mobility modes" (Morales et al., 2019), while mobility is a means to accessibility and can be defined as the "ease of movement" (Levine, 2011). Accessibility fits better to the topic of this thesis as the purpose of elderly to travel is about getting to activities and services. It is, therefore, accessibility that matters for elderly and not mobility. Still, the concept of mobility will be used in this thesis to discuss the functioning of the transport system. The following paragraph will introduce ageing in the Netherlands and focus on the northern part of the Netherlands.

Zoomed in on the province of Groningen

This research will thus focus on elderly that require some form of mobility service. However, elderly who are also mobile are still relevant for this research as they are tomorrow's group in need of mobility services. Besides, if society can keep them independent through good facilities and infrastructure, they are less dependent on transport services. One of the challenges in the province of Groningen in terms of demography is that small villages are getting smaller in population size (PBL, 2022) and thus less likely to have mobility services such as buses or trains. Other services, such as a doctor or pharmacy, lack a support base to keep their practices in town. Although villages might not shrink in terms of households, the average household size is decreasing (Sociaal Planbureau Groningen, n.d.). As a result, the villages often become too sparsely populated for facilities to be profitable, resulting in the disappearing of facilities (Haartsen & Venhorst, 2010). This concerns facilities such as supermarkets and pharmacies. The lack of facilities increases the need for mobility services that will bring elderly from sparsely populated areas to larger towns in the region. In urban areas, these challenges are not present. The younger population in a city like Groningen have many transport options. The bus is not used for reaching nearby facilities, but is preferred for reaching further destinations more quickly. Additionally, people who are still quite mobile, like younger inhabitants are prepared to walk longer for a bus station than people with a worse mobility (often elderly) (CROW, 2021).

Therefore, bus companies tend to straighten lines to improve the frequency. Moreover, shorter and faster lines are cheaper for bus companies. As bus networks in the Netherlands serve entire provinces, this does not only affect inner city accessibility, but also affects rural accessibility. People thus must walk further to a bus stop if bus lines only follow main roads and do not enter neighbourhoods.

Bus lines that run inside neighbourhoods instead of going via main roads are more difficult for bus systems. Bus lines in the city of Groningen tend to go from one edge of the city straight to the other via the main roads. The straightening of bus lines makes a trip to the local supermarket or community centres quite often impossible by bus.

This research will divide its advice and outcomes into three subgroups; large cities, small cities and large villages, and small villages. This is relevant as different densities require different solutions. Moreover, also in large cities there are still elderly who need good accessibility.

In the province of Groningen, only the city of Groningen can be seen as a large city. Small cities and large villages are combined in this research as they both have basic facilities and services. These range from Winschoten to Wagenborgen in population size.

Small villages are villages that have limited facilities and are dependent on large cities or villages in the region. Meedhuizen is such a village.

The three different subgroups; large cities, small cities and large villages, and small villages. The distinction is based on the degree of urbanisation; 1 – large cities; 2 to 4 – small cities and villages (see figure 5); and 5 – small villages (see figure 6). Figure 7 gives an overview. This research thus distinguishes between different urban densities to detail the level of services and differences in accessibility.

Figure 5: Wagenborgen (a small city or large village)

Figure 6: Meedhuizen (a small village)

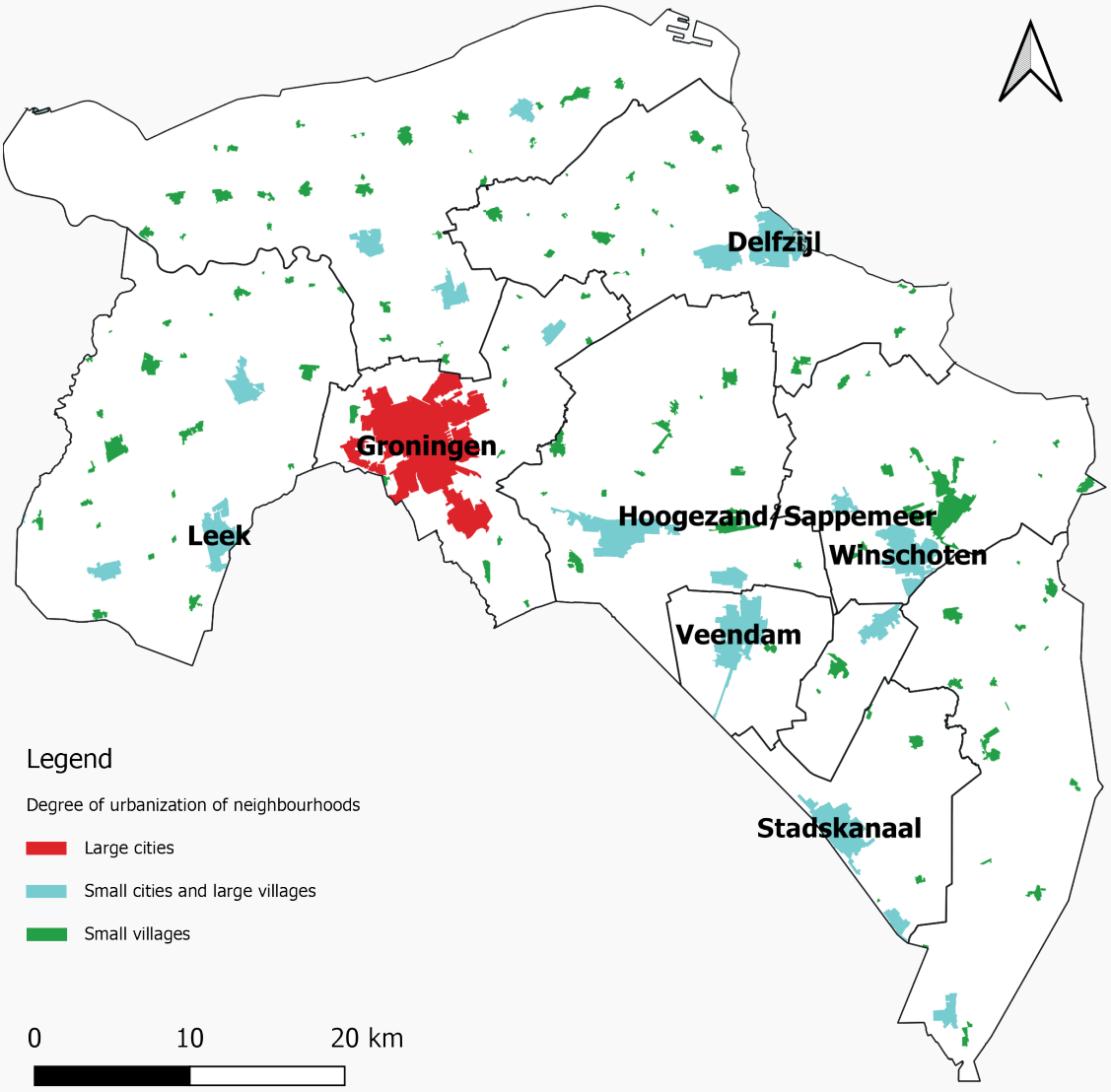


Figure 7: Degree of urbanisation of neighbourhoods.

Research gap

While some studies focussed on specific parts of mobility, such as the route choices of elderly (Borst et al., 2009), others generally focussed on inclusivity and healthy ageing. However, there is little research about these topics combined, focusing on a specific region. As Douma et al. (2015) suggest, further research is needed "[…] to focus on studying conceptions of subjective well-being for older adults with a variety of individual and environmental characteristics such as […] rural or urban living environments" (p.237). Additionally, Böcker et al. (2017) state that "[…] more quantitative and qualitative studies are required to investigate the effects of urban environments and processes on elderly mobility in more detail (e.g. in relation to the quantity and quality of public transport, walking and cycling infrastructure, distances to services, specific types of green space), on smaller spatial scales (e.g. on a block or street level) and in more dynamic ways (e.g. while paying attention to the interactions with rhythms in traffic, pollutants and noises)" (p.848). This research will examine the effect on the accessibility of different urban environments, as explained earlier, and the quality and quantity of public transport in these different urban and rural environments. Moreover, it will look at how future-proof the system is and how it could better adjust to the growing ageing population in the region. This research will help not only decision-makers to design the public transport and DRT system more efficiently but will also help municipalities to better adjust their spatial planning to the growing demand of elderly.

Reading guide

Firstly, this research will give an overview of the relevant theories and create a basis for further analysis of the transport system. The analysis will consist of qualitative and quantitative parts. Interviews will give a good insight into the current network, the problems elderly experience, and the future technologies and innovations that can play a role. The quantitative analysis will help to get a better overview of where the neighbourhoods with large shares of elderly are, what locations have a relatively large distance to bus stops, and what the distance is to facilities such as pharmacies in the province of Groningen. The main goal of good accessibility for elderly in the Netherlands is thus to have healthy ageing and decreased loneliness.

Theoretical framework

This chapter will discuss the relevant theories concerning what is needed to keep elderly participating in tomorrow's society through good accessibility. The theoretical framework will consist of two themes; 1) travel behaviour and mobility demand in general and; 2) (healthy) ageing. The themes are brought together by the concepts of reversibility and connectivity (Osti, 2010). Bringing these concepts together summarises the idea of this research, creating an overview of the situation for elderly in the province of Groningen in terms of their activities, needs and travel behaviour.

The first part of the theoretical framework on travel behaviour relates to connectivity: the availability and accessibility of transport. The second part of this chapter will give an overview of the theories on (healthy) ageing and relates to reversibility; maintaining relationships. The part of the theoretical framework focussing on reversibility will look at healthy ageing, healthy life expectancy and subjective wellbeing.

Travel behaviour and mobility demands of elderly

Within the theme of connectivity a distinction has been made between the travel demand of elderly is and how internal and external factors influence travel demand.

Travel behaviour of elderly and implications for transport

The share of elderly is expected to be larger in the future and besides, elderly have also become increasingly mobile (Böcker et al., 2017). Ageing is thus not only a challenge for healthcare services but also transport services. It requires different thinking on how we plan our spatial environment and infrastructure. This thesis will focus on accessibility; however, it is impossible to think about accessibility and to not think about new housing developments and how the Netherlands should organise their healthcare. The result section will elaborate further on this. Elderly remaining more mobile has a positive effect on social inclusion and the independence of elderly but also has an increased impact on the environment. Next to the increased mobility of elderly, they started to rely more and more on public transport and their car (Böcker et al., 2017). The travel behaviour of elderly differs from youngsters as elderly make shorter and fewer trips.

Although the expectation is that elderly use public transport more in the future, it remains difficult to adjust public transport to a group that does not regularly travel. Because their travel behaviour is often unpredictable, it becomes less affordable for public transport to run buses frequently on routes with a large share of elderly. They will thus run less frequently and might reduce the number of stops. The reduced frequency will decrease the likeliness of elderly to take the bus as it might not be driving when customers need it. The reduced likeliness of elderly to use public transport is a downward spiral that needs a solution to keep elderly mobile now and in the future. If elderly are less likely to take public transport, it could influence the accessibility of elderly.

Public transport in different urban densities

Before explaining the factors that influence the transport demand, it is first necessary to explain the basic principles of travelling according to Bannister (2008). The author names two fundamental principles for people to travel; 1. '[…] travel is a derived demand and not an activity that people wish to undertake for its own sake" (p.73); and 2. "[…] people minimise their generalised costs of travel, mainly operationalised through a combination of the costs of travel and the time taken for travel" (p.73). The travel costs and time taken for travel differ due to the different densities as public transport is less available in rural areas. Large cities have a higher density, which makes it easier to exploit bus routes and to have higher frequencies on those routes. Nevertheless, COVID-19 exposed that the assumption that travel is not an activity is wrong as people embrace "fake commutes" (Bogart, 2020).

Large cities

In the case of the province of Groningen, the only large city is the city of Groningen. The available transport in the city consists of a bus and train network and local neighbourhood buses. The bus network is organised by Qbuzz. The public transport organisation got the exclusive right to exploit the bus network in the province of Groningen and Drenthe (CROW, 2022). These concessions are partnership between public organisations (the province of Groningen and Drenthe) and private parties (Qbuzz) (Europa decentral, n.d.). The provinces of Groningen and Drenthe are, via the OV Bureau Groningen Drenthe, playing an active role in the design of the transport network and are able to adjust if needed. The following services are part of the concession 2020-2029 (Gemeente Groningen, 2017):

- Providing travel information on the bus transportation and connecting modalities in the chain
- Exploitation of service points
- Collecting passenger revenue
- Deploying public transport stewards for card control and social safety
- Data management and supply.

The network in Groningen is optimised for travelling through the city. When seeing the fast bus network in and around the city of Groningen (only Q-link buses) as an independent system, you can compare it to metro systems worldwide. Therefore, the state of the network can be measured by calculating the Degree of Connectivity and Complexity according to the graph theory (Derrible & Kennedy, 2009). In figure 8 the theoretical application of Derrible and Kennedy (2009) has been applied to the case study of Groningen, showing the connections (34 edges) and stops (23 vertices). The ratio between the edges and vertices can be used to calculate the Complexity. The ratio gives it a complexity score of 1,48 (34/23) and a degree of connectivity of 0,54 (34/(3*23-6). These scores can be plotted in figure 9 to compare the state of the network to other networks. The network of Groningen can be found in phase two. Being in phase two means that Groningen has a decent network. The main improvements can be made by making connections between already

existing stops. That would make the network more robust. However, although the city has an efficient and well-operating network, its main focus is students and other frequent travellers. This means that bus stops are further away from homes to have faster travel times due to the straightening of the bus lines. Faster bus lines mean that a higher frequency of buses will be easier, positively affecting the decision to choose the bus as a mode of transport (Abe, 2021). Moreover, sustainable cities for transport should have over 25.000 inhabitants (preferably 50.000) and a minimum density of 40 persons per hectare (Bannister, 2008).

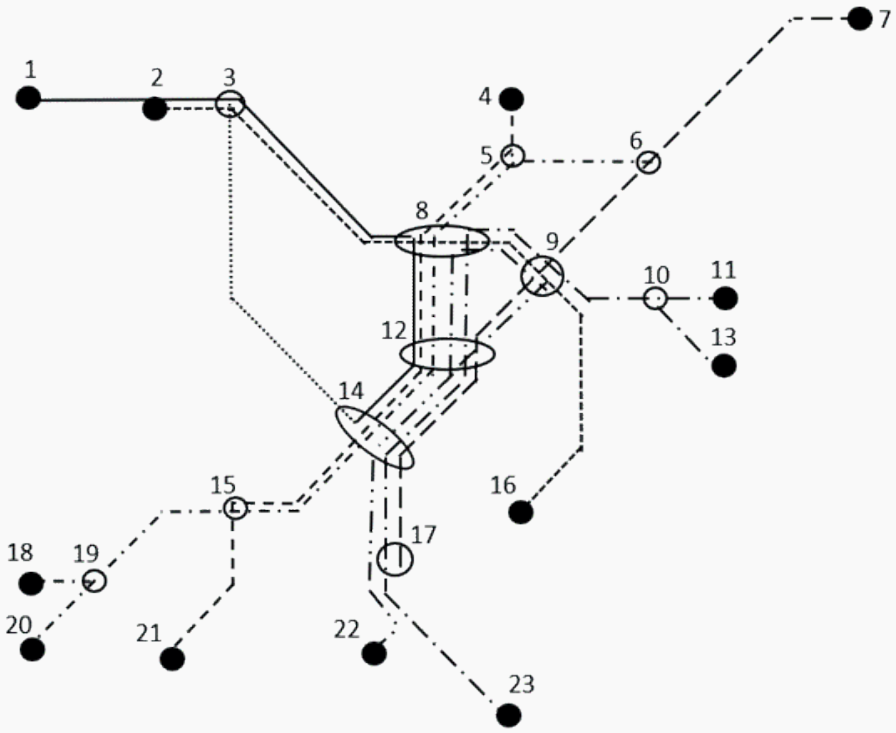


Figure 8: The network of Groningen according to the graph theory (own work)

Besides the Qbuzz network in the city of Groningen, there are local neighbourhood initiatives to bring people around using a neighbourhood taxi. For a small fee, customers can be driven to their destination inside the neighbourhood (WIJ Groningen, n.d.). These initiatives aim to help people participate in society by providing suitable transport (De Buurtvlinder, n.d.).

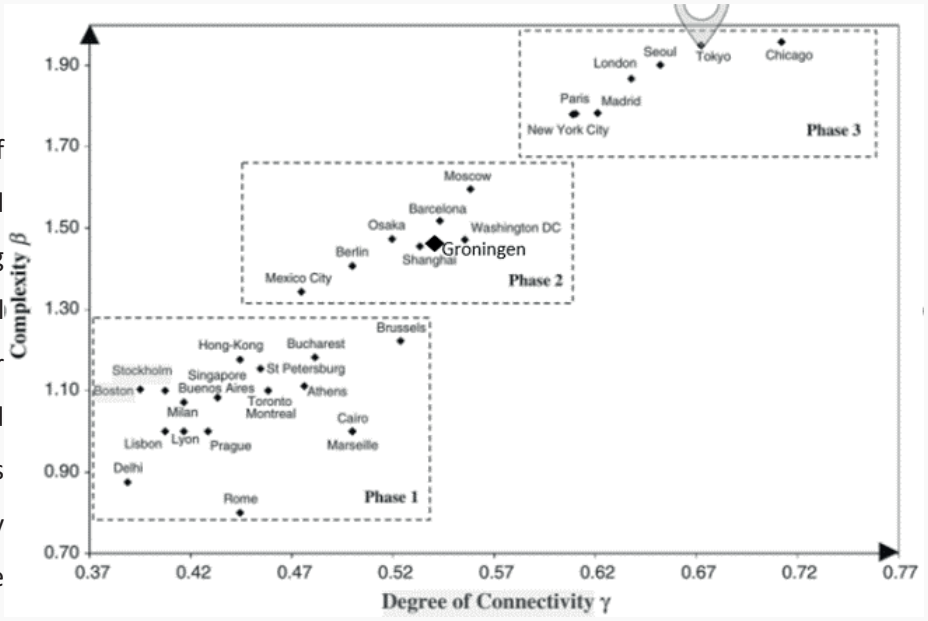


Figure 9: The network of Groningen compared to large metro networks (Derrible & Kennedy, 2019)

Small cities and large villages

The small cities and large villages are often connected by regional bus lines that pass through the cities and villages. Some are fast connections to the city of Groningen, while other lines are often slower and have more stops. To create a close-knit network, Publiek Vervoer was created in 2018 to help transport people who cannot get to a bus stop by themselves. Elderly in these regions often have to travel further to services as the lower density in these villages also provides fewer essential services.

Small villages

In small villages, there are often no services, and there is rarely a frequent bus line. Elderly are thus more dependent on their surroundings and otherwise on DRT. Elderly have often lived all their lives in these villages and cannot see themselves moving to a city or village with more services and better connections. They often rely on strong communities.

What influences the travel demand?

Not only is there a difference between age groups, but also between gender. Older women make in general, fewer trips than men. Moreover, if they make trips, women rely more on the bus than on a car (Li et al., 2012; Schmöcker et al., 2008; Hjorthol et a., 2010) as men prefer to keep their cars when they get older. Women are more likely to get rid of their vehicles. However, generally, car usage by elderly decreases and their public transport usage increases (Böcker et al., 2017). Because elderly travel less, their residential environments are important (Collia et al., 2003). Also Böcker et al. (2017) concluded that elderly travel less than non-elderly, but not by much. Elderly make on average 2.9 trips per person per day while non-elderly make 3.2 trips. Elderly, therefore, rely slightly more on their nearby facilities and resources for interaction and daily needs.

Being closer to leisure facilities might stimulate elderly to go out. This assumption would suggest that elderly living in dense urban areas are more tempted to go undertake leisure activities than elderly in rural areas. However, a German study (Scheiner, 2006) concludes that the level of urbanisation does not affect the frequency of out-of-home leisure activities or the distance travelled to out-of-home activities. Moreover, the level of urbanisation, according to the same study, also does not affect unfulfilled activity wishes and the satisfaction of their leisure activities. This would mean that, in the province of Groningen, there would thus not be a difference between the three levels of urbanisation, as stated in the introduction. Böcker et al. (2017) find that education plays a role in the number of trips individuals undertake. Lower educated individuals make fewer trips than higher educated individuals. The article also states that elderly, once they have retired, travel much more during weekdays than at the weekends. Also external factors influence the travel patterns of elderly. If elderly live in a relatively green environment, they tend to travel less, which would suggest that elderly living in small villages travel less than elderly living in a large city as these villages are often surrounded by more green. Finally, extreme weather such as extreme heat and storms causes elderly to cancel their trip plans more often than non-elderly. Therefore, heavier rains and increased temperature in the Netherlands in the future (KNMI, 2021) will decrease the likeliness of elderly to go out at certain times of the year.

The most significant difficulty for older adults to use public transport is getting from home to a bus stop or, even more complicated, a train station (Hess, 2012). It is dependent on urban and spatial characteristics and how likely it is for them to take the bus. The research (Hess, 2012), with the USA as a case study, shows that the average actual walking distance to a bus stop for people who use the bus is around 334 meters, while the average distance is over a kilometre for people who do not use the bus. Moreover, the study shows that 64% of the bus users underestimate the walking distance toward the bus stop. Underestimating the walking distance could be solved by placing better signs in the

neighbourhood with the direction towards the bus stop and the walking distance. According to the study (Hess, 2012), the assumption of a five-minute walk to public transport might be a better guideline. The assumption has been based on research by Ammons (2001), Demetsky and Lin (1982), The US Federal Transit Administration (1996) and Levinson (1992). However, five minutes does have its limitations as different urban forms in this study mean different travel distances. For example, someone walking five minutes in a small village might get further than someone walking in a busy city where waiting for traffic lights is part of the walk. Both spend a different amount of effort while the distance that is covered differs. According to a study in Florida, older adults living 200 meters away from a bus stop use the bus over three times more than people living over 400 meters away (Neilson and Fowler, 1972). Knowing these influences on the likeliness to travel helps better to estimate the travel demands of elderly per municipality and can help to better adjust to different weather forecasts.

Due to better online connectivity between people, there is less need to be spatially connected (Kaufmann et al., 2004). There is thus not always a need to travel. On the other hand, mobility is the "main means by which people regulate their lives" (Kaufmann et al., 2004, p.297). Mobility keeps a society active, and people are either included or excluded, according to Kaufmann et al. (2004). As facilities are being increasingly placed in regional centres, mobility is what can reduce separation (Rosenkvist et al., 2010). Elderly in the mentioned research expressed their concerns as they needed help with the ability to go out of town. This highlights that mobility deals with external challenges, as Rosenkvist et al. (2010) try to explain. These challenges could be the frequency of public transport, the distance, or even the walkability of the route toward bus stops, for example. The last challenge, that has been explained in the previous paragraph, would relate to the "tackling the physical environment is a basic prerequisite" category (see figure 10). If the outside environment is not attractive enough for people to walk in it creates a barrier that limits elderly's access to public transport and thus to being mobile in general.

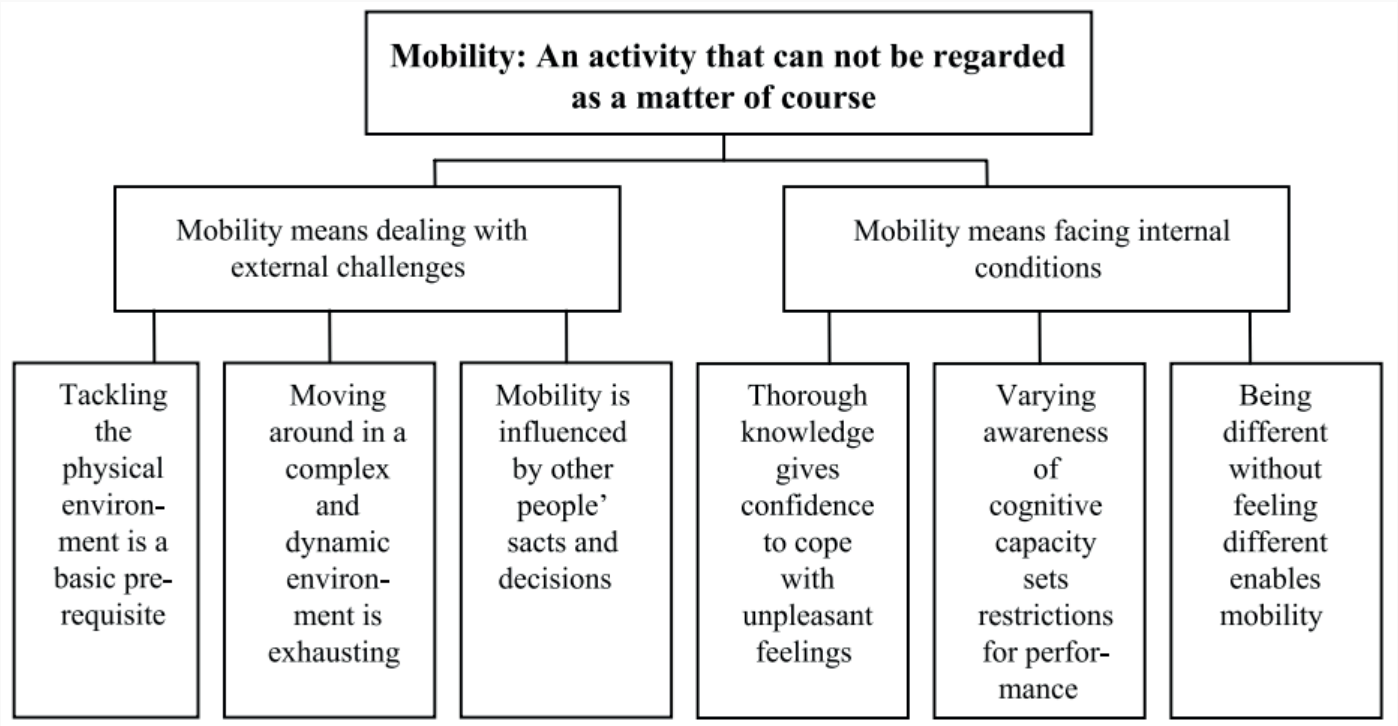


Figure 10: Overview of the external and internal challenges and conditions (Rosenkvist et al., 2010)

The lack of connections with other places could lead to differences in social structures. However, the distance people are separated from someone does not necessarily mean a weaker or stronger social link (Osti, 2010). The connectivity is linked to the concept of reversibility in the same article. Reversibility is "conceived as the capacity to maintain relationships (reciprocity)[…]" (p.298) and helps to enclose the debate on inclusion versus exclusion. Connectivity summarises the concept of motility, whether transport is available and accessible by the users.

The distinction between connectivity and reversibility (figure 11) helps to help place the different types of rural situations in the proper context and to show the direction that rules, regulations and initiatives have. For many rural areas, the desired direction is from marginal rural (3) to networked rural (4). However, the current tendency, according to Osti (2010), is toward liquid rural due to the individual use of private cars. Seeking a good form of connectivity is essential as the policy in the Netherlands is to let elderly stay in their own homes longer. A decent functioning transport system could help stimulate this tendency. However, mobility in rural areas is also difficult due to the heavily dispersed activities. Tourism, sports and leisure activities are often not in the same place and thus require multi-directional mobility (Otis, 2010). Although there are fewer commuters in rural areas then in urban areas, people from rural areas travel much further (1.6 times versus people in an urban environment) regardless of the mode of transport, according to a study in Northern Italy (Otis, 2010). While the theoretical principle is applicable to our case study, this factor can logically not be applied to the Netherlands as the spatial layout is much different, but it does highlight the struggle of people in rural areas. Nowadays the car is the primary mode of transport in Europe. However, this research notices that elderly are not always able to drive a car. The research based in Northern Italy mentions that car-sharing and carpooling as alternative to car ownership are difficult to organize in rural areas as people live scattered. The Dutch situation is different, as the Dutch spatial planning regulations have created compact cities and villages. Although villages in rural areas are thus small in size, they are still relatively dense. One of the solutions mentioned by Otis (2010) is a demand-responsive transport system (DRTS), which will be explained in the following paragraph.

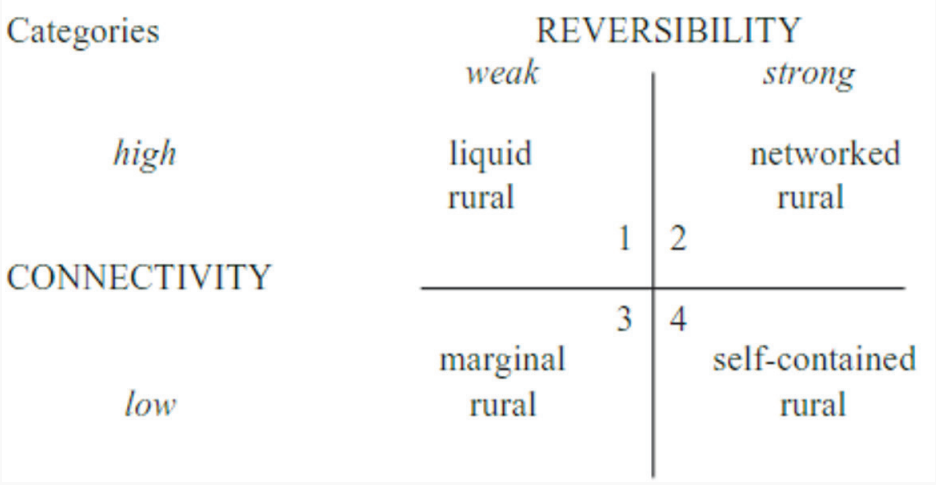


Figure 11: Typology of the social situations of rural areas (Osti, 2010)

Introducing demand-responsive transport

The demand responsive transport system (DRT) is a system where people can call for a bus and where they can be transported to either a nearby hub or destination, dependent on whether they are seen as disabled or not. The idea is that DRTs serve areas with a low population density, stimulate social cohesion and bring lower operational costs. Secondly, it can make public transport sustainable in rural areas (Lakatos et al., 2020). This is because serving areas with a low transport demand comes with high costs. The DRT system can be compared to what is called Publiek Vervoer in the province of Groningen. The disadvantage of this system is that buses often have low seat utilisation (Torkjazi & Huynh, 2019).

There are different strategies of DRT; no zoning, independent zoning and zoning with transfer points (Torkjazi & Huynh, 2019). No zoning is when an entire city is a single zone. Noted that the research by Torkjazi and Huynh has Los Angeles and Chicago as case studies, the four DRT regions in the province of Groningen can be seen as such a 'city' as mentioned by the article. Independent zoning allows providers to bring customers from the providers' zone to other zones. It allows vehicles to travel outside their original zone to drop off customers. The zoning with transfer points strategy restricts vehicles from going outside their zone. Customers thus have to travel via the regular pre-scheduled transport systems to other zones. Moreover, there is the proposed scheduling strategy, which allows drivers to consider picking up customers who did not schedule their trip within a specific range of any stop location (Torkjazi & Huynh, 2019). Figure 12 shows this strategy. The customers are 'P', and the destinations are 'D'. Regular schedules would pick up P (circle) first to go to D (circle). However, this strategy would make a slight detour to fill the seats left by person P (circle), leaving at destination D (circle). It would pick up P (square) to drive with the least number of empty seats possible. The grey circles are the dynamic response areas (DRA). The size of the DRA influences the increase in in-vehicle travel time. The study results are that an increase in DRA and having a DRA in general, barely increase the in-vehicle travel time and that this strategy can serve more customers using the same fleet size. Torkjazi and Huynh (2019) state that in a typical DRT system, the vehicles are assigned via a central system. When the bus is driving with a customer, it does not deviate from its route. There is thus no room for serving dynamic requests. The proposed scheduling strategy does leave this room and gives more power to the driver to deviate from the route. This can either function as an agent-based simulation model (Torkjazi & Huynh, 2019) or via a centralised system using intelligent software to optimise routes.

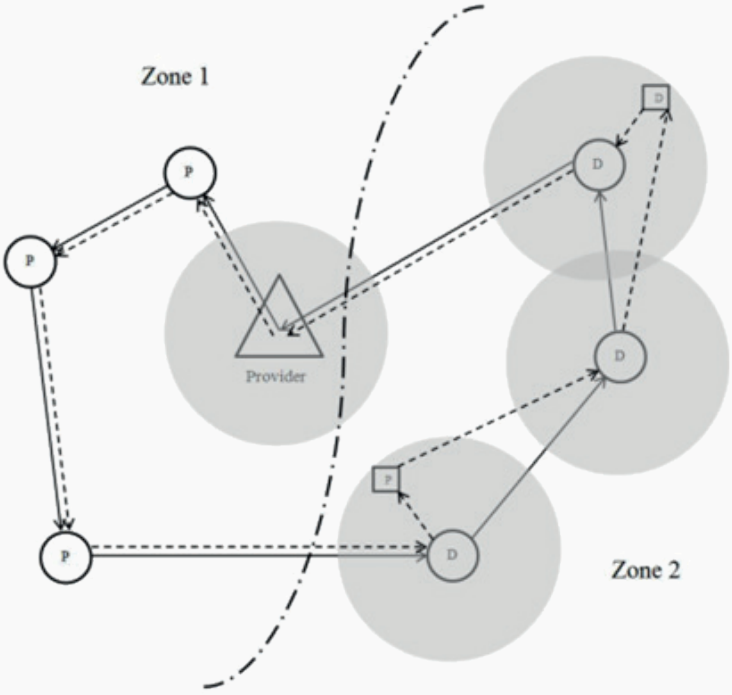


Figure 12: Illustration of proposed scheduling strategy (Tokjazi & Huynh, 2019)

The Dial-a-Ride Problem (DARP) is another concept that looks into the difficulties of DRT systems. With transporting customers, a company always has a balance between minimising operating costs and reducing user inconvenience (Cordeau & Laporte, 2007). Like the strategies above, the DARP distinguishes between a static and dynamic mode, whereas the dynamic mode is similar to the proposed scheduling strategy. Cordeau and Laporte (2007) state that there are excellent heuristics for the static case and that a shift needs to be made towards a more dynamic form of DRT. Advanced systems such as vehicle positioning systems could help to better adjust to the dynamic circumstances. It is thus essential to keep an eye on existing and developing technologies to make DRT more efficient. The following paragraph will introduce an example of DRT.

Kutsuplus: A pilot project in Helsinki'

Kutsuplus is a pilot of flexible micro transport services (FMTS) in the Helsinki Metropolitan Region. The FMTS is a way to respond to the rapidly ageing population (Jokinen et al., 2019). The article states that "[…] MTS can provide an alternative between the high flexibility and high-cost taxi service, and the low price, lower quality, and the medium-flexibility bus-based public transport" (p.123). Information technology can make FMTS easier, as in the past real-time booking and routing were still tricky, as well as high call centre costs. The availability of smartphones is mentioned as one of the solutions (Jokinen et al., 2019). However, one of the significant problems of FMTS is financial stability. The main objective of Kutsuplus was to convince car users to use public transport instead. The organisation tried to achieve this by 'providing a comfortable and easy-to-use service, which is flexible in terms of travel time, route, service level, and price' (Jokinen et al., 2019, p. 124). The customer requests via a smartphone or computer and then receives trip suggestions. The suggestion is based on the customers' preferences (number of persons, a destination address, preferred pick-up time). The highly advanced automation of the process saved the time of a human operator. However, the operation costs of Kutsuplus were still high, mainly due to the high wages of the driver, although a small fleet could still transfer a large number of customers. Jokinen et al. (2019) mention that self-driving vehicles as a future technology could help to reduce these costs and make FMTS more financially sustainable. The pilot had three different service classes, of which the expensive class was removed first, indicating the lack of interest in a faster but more expensive form of transport. People thus seem to look at the costs of travel over comfort. In other words, making one mode of transport cheaper or the other mode more expensive might stimulate people to change modes of transport. The least expensive class often had the same service level as the less expensive class during off-peak hours. Learning that differentiation in classes should also result in different levels of services (travel time in this case). A regression analysis learned that customers are willing to pay €0,11 more per minute they save (Jokinen et al., 2014). Nevertheless, the mean age of Kutsuplus will likely be different from that of the DRT in the province of Groningen, meaning that it is not fair to apply the same numbers to the different regions. The main lesson of this pilot is not to see FMTS as a financial system on its own, being judged by its high operational costs, but to see it as an addition to the system, contributing to other societal benefits. The example showed how technology could help to make DRT more successful but also highlighted the difficulties of DRT in terms of labour costs. Also, an incentive for comfort and speed in exchange for

extra costs did not appear successful. The following paragraph will look at scenarios of what technology could bring for transport.

Future of autonomous vehicles

The KiM, Netherlands Institute for Transport Policy Analysis, has four different scenarios regarding the automation of cars (Tillema et al., 2015). This research will discuss the four scenarios and elaborate on how/if they can help elderly in the future to become more mobile.

Scenario 1: Mobility as a service: any time, any place

This scenario means that consumers are willing to share their mode of transport. Mobility has thus become a service. Sharing cars has the advantage that fewer cars are necessary to service the same number of people. However, as people still see cars as status symbols, it will not likely happen in the future. Besides car ownership being regulated, the cars are fully automatic in this scenario. Full automation would be ideal for elderly as they can travel door to door even if they cannot drive. Moreover, they only have to pay for the car when using it. Car ownership can sometimes be relatively expensive for elderly as they rarely use the car. This scenario will thus make travelling from A to B much easier.

Scenario 2: Fully automated private luxury

This differs from the previous scenario as cars are privately owned. Technology in cars is well developed, which allows cars to be fully automated. This will help elderly, as explained in the first scenario, apart from the lower costs. However, if elderly travel more as a result of travelling being more effortless than it is now, a private car might eventually be cheaper.

Scenario 3: Letting go on highways

This scenario assumes that cars are not fully automatic and can only drive independently on highways. Besides, only a tiny percentage of cars is shared. This scenario is not attractive for elderly as they will still have to drive large parts of the journey. However, better technology could make driving safer and thus make it more attractive for elderly to keep driving.

Scenario 4: Multimodal and shared automation

Car driving will still not be fully automated, but car sharing is widely used. Car sharing could reduce costs for elderly but still has the same problem as scenario 3.

Thus, there are different scenarios of what technology could bring to make travelling easier for elderly. However, this thesis also looks at the group of elderly still having good mobility due to good health. This group is not yet dependent on transport services.

The influence of cycling on the accessibility of elderly

This research has so far discussed the negative and positive aspects of external factors on the travel demand of elderly but mainly focused on public transport and DRT. However, the Dutch cycling culture cannot be forgotten. Owning a bicycle and having a decent infrastructure to use the bicycle positively affects the health of elderly (Böcker et al., 2017). According to the study, elderly in the Netherlands are less likely to use the bicycle over walking when they live in urban areas instead of rural areas. Elderly in rural areas use the bicycle more (Kemperman & Timmermans, 2014), reducing the demand for transport services as long as elderly feel safe to bicycle.

In the Netherlands, many people cycle due to the low risk; cycling is relatively safe in the Netherlands. People who are risk-averse people, such as elderly, often have no problem cycling in the Netherlands (Pucher & Buehler, 2008). People aged 30 to 40 and 65 to 70 travel on average once every two days by bicycle, while people older than 70 travel once every three days in the Netherlands (CBS Statline (a), 2021). Making cycling as attractive as possible could help to keep elderly longer on the bicycle. If they still 'dare' to travel by bicycle they will be less demanding on public transport services. In Dutch cities, cyclists often have priority over cars. Moreover, some cities, like Groningen, make it hard to enter the inner city by car to stimulate cycling. The municipality of Groningen plans to give more room to public transport and cyclist in their newest mobility vision (RTV Noord, 2021). Subsequent, it plans to reduce the speed limit from 50 km/h to 30 km/h in streets connecting neighbourhoods. The speed reduction will make cycling even safer. Pucher and Buehler (2008) believe that an increase in safety will lead to higher levels of cycling.

Unfortunately, the number bicycle fatalities in the age group of 70 to 80 in traffic accidents is more than twelve times higher than those in the age group of 30 to 40 (CBS Stateline (b), 2021). Traffic calming, as will be applied in Groningen, will, according to Pucher and Buehler (2008), help to increase traffic safety. This will also positively affect the relatively high number of casualties of elderly in the Netherlands. However, these measures are now being applied in the city of Groningen and not (yet) in small rural villages in the province. Thus, it will only help make cycling safer within the city of Groningen. Elderly in small rural villages often travel further for facilities and, above all, on regional roads where they cycle on the same road used by cars. Pucher and Buehler (2008) mention special cycle lanes as a solution. The province of Groningen is working on 'snelfietsroutes' or 'doorfietsroutes' (direct cycling connections) to connect rural villages better with cities that accommodate facilities (see figure 11). A safe and fast cycling network could thus help to keep elderly on the bicycle and reduce the demand of elderly on transport services.

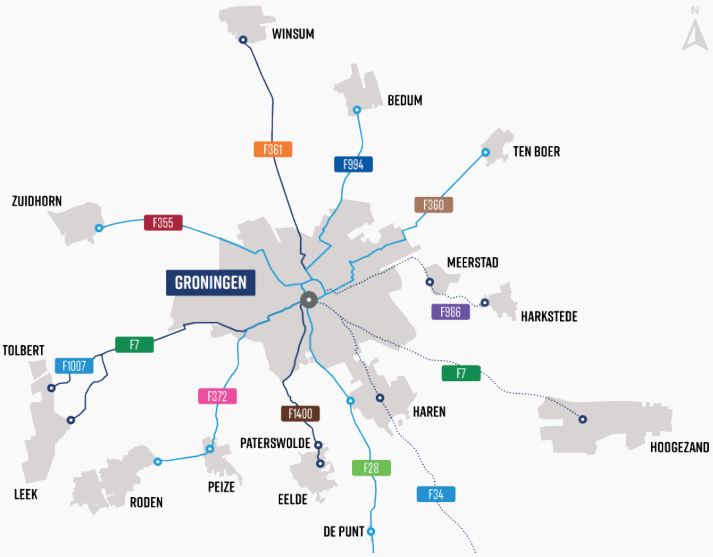


Figure 13: Overview of the (planned) cycling network to and from the city of Groningen (Doorfietsroute.nl, n.d.)

Different reasons to travel

The past paragraphs mainly looked at different influences on the travel demand of elderly, while this section will go deeper into the reasons for elderly to travel. Two reasons to travel for elderly can be distinguished; 1. Travelling to services and; 2. for activities and leisure. This research sees supermarkets, general practitioners (GPs), pharmacies and hospitals as important services. For the last category, activities and leisure, it is interesting to look at the unfulfilled activity wishes of elderly and, more importantly, why they are not fulfilled and how they could be fulfilled. Scheiner (2006) mentioned that the level of urbanisation does not influence out-of-home leisure activities. According to Scheiner (2006), unfulfilled activities can be explained by bad health, employment and gender, as women generally have more unfulfilled activity wishes than men. This follows the line of thought mentioned earlier in this chapter: men make more trips than women when of older age, and women use the bus more than men. The difference might be caused by either the longer life expectancy of women and thus poorer health at a higher age or women who find making trips at a higher age more difficult. Employment as a reason is explained as: "[…] persons who are still in employment often have more unfulfilled wishes than those who are retired. This might be explained by their restricted time budget, especially while being in an age when the view is already directed towards the post- thus there might be a tendency to postpone wish-fulfilment at this stage of life" (Scheiner, 2006, pp.166-167) According to the article, elderly in general do not have noticeably more unfulfilled activity wishes than other age groups. An explanation could be that elderly compare themselves to others in their age group and thus do not have noticeably more unfulfilled activity wishes. On the other hand, a more recent study by Luiu et al. (2017) did see more unfulfilled activity wishes in older age groups. Especially the pursuit of leisure and visiting friends and families are the most unfulfilled activity wishes.

So far, this part of the theoretical framework has looked at the factors influencing travel demand, how transport can be arranged, and the different reasons to travel. These topics provide an overview of the factors behind the accessibility of elderly, which influences how they age 'healthy'. The following section will investigate how elderly age and how this health can be conceptualised.

The effect of accessibility on healthy ageing

An important concept in getting older is how one gets older; Healthy Ageing. One way to measure Healthy Ageing is by the Active Ageing Index (AAI) (Unece, n.d.). The AAI consist of four domains: Employment; Participation in Society; Independent, Healthy and Secure Living; and Capacity and Enabling Environment for Active Ageing. This research will mainly look at the last two domains, and within particular two indicators, Independent living and Social connectedness. It will use these concepts as they relate to the research topic; reducing loneliness by good accessibility. Moreover, both indicators relate closely to the different reasons to travel. Travelling to facilities connects to having an independent life, while travelling to leisure activities connects to having social connections. The Netherlands is the third-best country in the EU after Sweden and Denmark on the AAI (Unece, 2019).

Independent Living

This indicator says something about the percentage of people aged 75 and over living independently (Unece, n.d.). Although it sounds contrasting, this indicator is important for this research to highlight as many of elderly depend on modes of transport or others to go from a to b when they live independently. A possible hypothesis is that there is more demand for a form of transport in rural villages with a high percentage of people living independently. This research will thus look at the degree of elderly in villages to highlight areas with a high degree of elderly and a considerable distance to services.

Social Connectedness

Social Connectedness measures the percentage of people over 55 "that meet socially with friends, relatives or colleagues at least once a week" (Unece, 2019, ch. 4). This is an essential aspect of Healthy Ageing as it says something about the mental and physical aspects. Especially during the COVID-19 pandemic, loneliness was an increased risk. However, social connections can sometimes exist within a small perimeter of people's residential homes and can thus be done by foot.

Life expectancy

The life expectancy in the Netherlands is expected to grow from 81.8 in 2018 to 85.4 in 2040 (RIVM, n.d.). In 2020 the life expectancy of a man in the Netherlands was 79,7 years and 83,1 years for a woman (CBS (c), 2021). However, life expectancy says something about the expected life length from the moment someone is born and does not say anything about someone's health during those years. Secondly, life expectancy when reaching 50, for example, was in 2020 31,7 years for men and 34,7 for women, meaning that if someone is 50 years old, the person will likely become 81,7 years old as a man and 84,7 years old as a woman. To look better at the health conditions people spend their lives in, it is helpful to look at the Disability Adjusted Life Years (DALY) (figure 14). The DALY can be calculated by taking the sum of the Years lived with Disability (YLD) and the Years of Life Lost (YLL). The YLL is caused by dying earlier than the average life expectancy predicts. The increase in life expectancy can mean three things: 1) the healthy life length increases; 2) the time spent with a disease or disability increases, or; 3) both. The ideal situation would be to increase life expectancy by an equivalent increase in healthy life expectancy (Robine & Jagger, 2005). The authors of this article mention the debate between quantity and quality of life, as a longer life does not necessarily mean a better life.

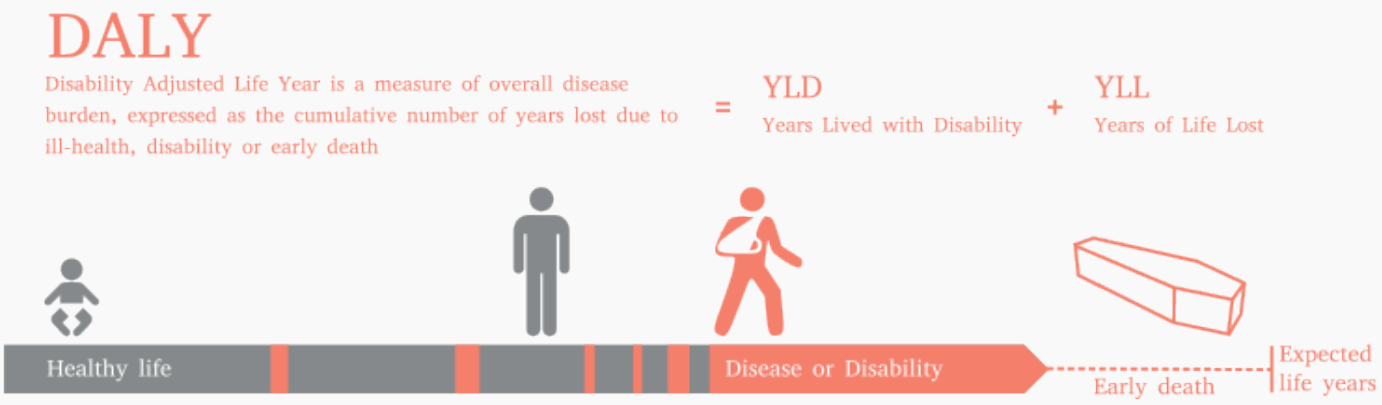


Figure 14: Explenation of DALY (Wikipedia, n.d.).

This research primarily focuses on the quality of life in terms of keeping elderly mobile which could help to increase life satisfaction overall. Increased life satisfaction and, therefore, better mental health could also positively impact the life length. The subjective well-being at older age has been researched and expressed in a word—cloud (figure 15) (Douma et al., 2015). Subjective wellbeing "[…] is a field of academic research that aims to explain individuals' global evaluations of their lives" (p.229). Social life has been mentioned twice as often as the aspects of 'Activities' and 'Health'. Without good accessibility, it will be hard to fulfil the first two aspects; social life and activities. Accessibility thus plays a crucial role in the subjective well-being of elderly. However, social life is seen as more important among participants aged 65-74 years than among participants aged 85+ (Douma et al., 2015). This difference could either mean that elderly aged 85+ do not find it necessary to have a social life or find their joy elsewhere as they accept that travelling to social contacts is too tricky. Furthermore, elderly might not be familiar with tools to maintain social contacts, such as smartphones, which might change in the future as elderly are more acquainted with the technology. Nevertheless, the opportunities should be there to be included in the society.

Figure 15: Subjective wellbeing of older age (Douma et al., 2015)

Social exclusion

Social exclusion can be defined as "[t]he process in which individuals or entire communities of people are systematically blocked from (or denied full access to) various rights, opportunities and resources that are normally available to members of a different group, and which are fundamental to social integration within that particular group" (Inoi et al., 2017, p.4220). Social exclusion has its spatial element in the form of accessibility planning, seen as "the ability to get to essential services: education, employment, health and others, and to food shops, as well as to sporting, leisure and cultural activities" (Social Exclusion Unit, 2003). It helps to define Socially Perceived Necessities (SPNs) to test what should be seen as social exclusion. SPN can be to be able to reach the hospital. However, social exclusion can also be only being able to travel a short amount of time or distance (Chikaraishi et al. 2011). Limited car access stimulates social exclusion (Hine & Mitchell, 2016). This is why Stanley and Lucas (2008) emphasise the importance of public transport in battling social exclusion. Access to information, the last mile, and user-friendliness of the transport system

determine the amount of social exclusion elderly face. According to Hine and Mitchell (2016), social exclusion is about non-participating in life-shaping activities such as leisure. The socially excluded people can be found in scattered and clustered areas, each having different problems. What helps is better serving them via information technologies (Hine & Mitchell, 2016). Public transport companies are trying to find routes with the greatest efficiency and the largest market share and do not focus primarily on social inclusion. However, in the case of Groningen, the options are there in the form of Publiek Vervoer. Church et al. (2000) note that social exclusion is not only in the functioning of the transport system but just as much in the location of facilities and opportunities people are trying to visit. Van Hoven et al. (2012) emphasise the housing market's role as a spatial factor. It is essential to understand the role of social inclusion in the transport system and spatial placements of facilities in ageing well.

The theoretical framework provided a foundation for qualitative and quantitative analysis. It gave an overview of the functioning of the network and different modes of transport, what influences the demand of elderly, and what is important to healthy ageing. The result section will build further on these concepts.

Determinants of accessibility

The theoretical framework explains the factors influencing accessibility. As the conceptual model (figure 16) shows, accessibility is contributing to healthy ageing as it relates directly to the indicators 'Social Connectedness and 'Better Independent Living' of the AAI. The 'Social Connectedness' indicator measures the amount of meetings with friends, relatives or colleagues (unece, n.d.). A lack of confidence could be a barrier for elderly to undertake new activities (Glover et al., 2020). According to the article transport belongs to environmental barriers, which could harm healthy ageing. The theoretical framework explained the factors influencing accessibility. The conceptual model provides a visual overview of the variables that play a role in accessibility. Healthy ageing can be seen as the end goal, which good accessibility needs to contribute to. Nevertheless, this thesis focusses on the accessibility of elderly in the province of Groningen. Governments determine the playing field for private organisations running public transport. The rationale of governments also influences the likeliness of local initiatives to pop up. A government that stimulates initiatives, for example, might create a better atmosphere for initiatives to pop up than a government that only facilitates. Moreover, government decisions play a role in the subjective safety, attractivity of infrastructure for elderly and the quality of spatial planning. The choices made about these topics lead to a (un)attractive last mile, living close or far to facilities and activities as elderly, and a (un) attractive public transport system for elderly.

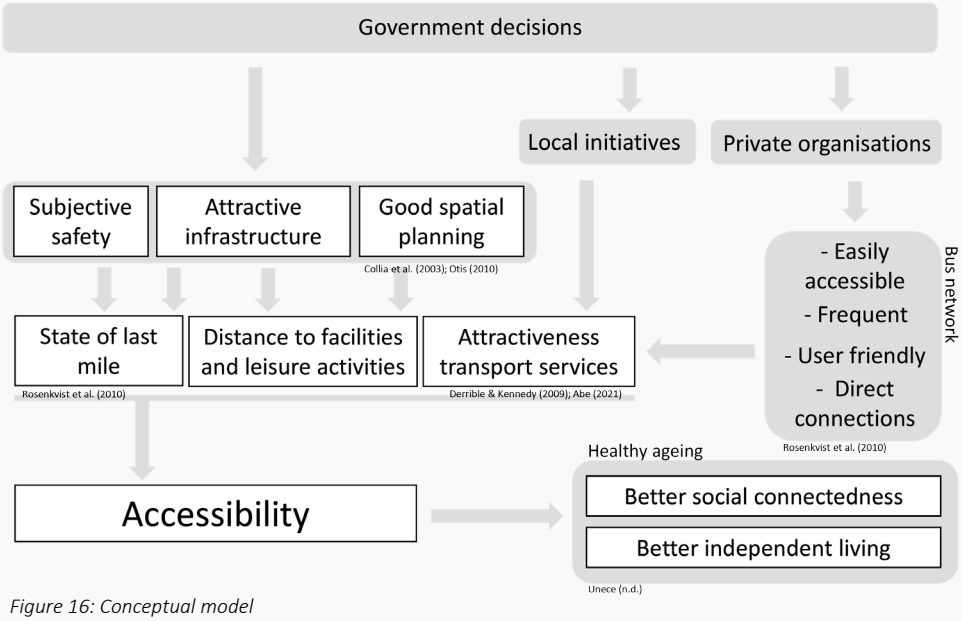


Figure 16: Conceptual model

Methodology

This research concerns the case study of the province of Groningen. In this methodology, the case study will be explained and the research boundaries have been determined. Furthermore, the following research steps will be discussed: a spatial analysis, data analysis, and interviews.

The view of this research is that the province of Groningen has diversity in urban and rural mobility systems and thus differences in accessibility. The idea is not only to get better insights into the system's functioning in the province of Groningen itself but also to draw lessons for other regions in the Netherlands. Groningen has regions facing ageing more severely than other regions in the Netherlands and is thus the first to face the consequences of a severely ageing population. This research found answers to the research question by collecting interviews, looking at existing literature about ageing and mobility in combination with an extensive data analysis about the province of Groningen and to see for each of the defined subgroups (large cities, small cities and large villages, and small villages) what the current situation is and the future trend.

This research deliberately uses secondary data analysis, spatial analysis and interviews. A survey targeting elderly would be impractical as elderly are difficult to reach via online surveys, and a physical form of surveying would be too time-consuming due to the scope of this research. Above all, an online survey would give a bias in the data as it would only reach elderly who can handle modern-day technology. The same technology makes it often so difficult for elderly to use public transport. It would thus miss out on a group that is highly relevant to this research. Moreover, it would be irresponsible to physically approach a large number of elderly in times of the COVID-19 pandemic.

Public transport ambassadors are a good alternative to a survey as they stay in close contact with elderly that are having difficulties using public transport. The ambassadors have a good understanding of how the transport system works and are thus able to translate different problems elderly face into shortcomings of the system. However, because they are public transport ambassadors, they often only see the elderly who have troubles using public transport. They miss out on the elderly who are not interested in public transport at all or the elderly who have no difficulties at all using public transport. Nevertheless, this research believes that the public transport ambassadors represent a large group of elderly that are having troubles using public transport.

Relevant people from the province and municipalities have been selected, together with people from institutions, organisations and public transport ambassadors. The interviewees have been selected because they are expert on their topic, as explained in table XX. These professionals provided a holistic overview of the current and future challenges and the possible solutions, and they raised questions for the future. This researched aimed to interview experts on the public transport network, the organisation of DRT, the collaboration between regions regarding public transport and DRT and transport innovations. The interview on the Wmo-indicating process was seen as necessary after the first five interviews, and was not pre-planned.

This research thus applied the following methods;

- Analysis of current plans/ literature
- Secondary data analysis
- GIS analysis
- Expert interviews

Each sub-question required different methods;

- What are the accessibility needs of elderly now and in the future?

Answering this sub-question required interviews and secondary data analysis using current literature. Interviews with parties staying in close contact with elderly, like the public transport ambassadors, helped to get a better insight into the needs of elderly now and in the future. This research interviewed a policy advisor on innovation at the Ministry of Infrastructure and Water Management to get more insights into the future demands of elderly and what technology can do for this group.

- What are the current problems with transport for elderly?

This required interviews with the public transport ambassadors, Publiek Vervoer, the province of Groningen and executing companies. The public transport ambassadors gave insights into the problems elderly face, while the other parties gave insights into operating problems.

- What are the initiatives that try and help elderly participate in today's and tomorrow's society?

This answer has been required by researching current plans and raising questions during interviews on this topic.

- What are the main challenges ahead for public transport to serve elderly?

Interviews and spatial data analysis about the services in the proximity of elderly and the distance to bus stops helped to get a good insight into the different areas with high shares of elderly but large distances to services. Furthermore, the theoretical framework provided a better insight into the challenges in other countries / regions and will help to conceptualise the challenges.

Quantitative analysis

This research has executed a spatial analysis using GIS software. For the quantitative analysis, data has been used on transport routes, services (pharmacies, hospitals, supermarkets, GPs), and distances to bus stops to gain more insights into where public transport might not be sufficient for elderly and local initiatives or more local forms of DRT might be necessary. The spatial analysis evaluates only the situation within the residential boundaries ('bevolkingskernen' in Dutch) as the rural areas outside villages and cities can be seen as too sparsely populated to be relevant for this

analysis. The amount of elderly living outside the residential boundaries can be seen as negligible, as approximately 96% of the houses are inside the residential boundaries in the province of Groningen (PDOK, 2020). The spatial analysis is able to show differences between villages and regions better if it only focusses on residential boundaries. This research depends on available datasets, which might not always be 100% correct as facilities come and go. Moreover, some services could have been marked differently and cannot be mapped. However, the goal of the spatial analysis is not to find all the locations with large distances to facilities and list these locations but to get a better overview of the distances to services in general and the functioning of the bus network.

This research analyses the data using both Excel and QGis. To spatially analyse the data, some data needed to be transformed in Excel to make it easier to use and display in Qgis. Not only has this data been used as an analysis for this research, but it also helped to strengthen statements made by experts during interviews.

Qualitative analysis

The qualitative analyses consisted of structured and semi-structured interviews with experts on mobility for elderly and mobility in general. Five of the six interviews were conducted online. This research reached out to the interviewees via e-mail. All interviewees have been asked if they wanted to stay anonymous. Only one of the six interviewees wanted to stay anonymous. Secondly, all interviewees got the opportunity to see what has been written about their interview. All statements made by the interviewees are thus also approved by the interviewees. The interviewees got some general questions on ageing and transport, but the interviews mostly focussed on the topic the interviewee was an expert on, which differed per interview.The interviews gave insights into; how the public transport system currently is arranged and the pros and cons of the transport system in the province of Groningen. Secondly, the interviews went deeper into the needs of elderly, their demands regarding public transport, and how they currently experience public transport. By interviewing experts from different scales and perspectives, this research got a holistic overview of the province of Groningen. The different scales range from experts that have an overview of mobility and accessibility in general to local public transport ambassadors who understand the local needs of elderly. Interviewing local experts who are in close contact with elderly can be seen as an alternative to using a survey to get insights into the wishes and problems of this group. The number of elderly that will use DRT is primarily connected to the Wmo-indicating process. This research thus also interviewed an expert overseeing this process. A coding scheme to analyse the interviews has not been used as they varied topics and followed up on each other. The interview guides differed for each interview as the output of each interview also functioned as the input for new interviews. The interview guide can be found in appendix A.

To summarise, this research spoke to the following experts;

Interviewee number	Name	Role	Date of interview
1	Jaap Mulder	Contact for public transport and Publiek Vervoer in the province of Groningen	February 4 2022
2		Public transport ambassadors	February 10, 2022
3	Jan Bos	Director of Publiek Vervoer	March 4, 2022
4	Anita Medendorp- van der molen	Former director of UVO Vervoer	March 4, 2022
5	Liselotte Bingen	Policy advisor on innovation at the Ministry of Infrastructure and Water Management	April 8, 2022
6	Anonymous	A policy advisor with knowledge of the Wmo-indicating process working for a municipality in the province of Groningen	April 20, 2022

Table 1: Overview of the interviewees.

Name	Reason for selection interviewee
Jaap Mulder	Expert on public transport and Publiek Vervoer and representing the province of Groningen
Public transport ambassadors	They stay in close contact with the elderly and are able to summarize the difficulties of elderly with public transport and DRT
Jan Bos	Expert on Publiek Vervoer and able to provide a perspective from the *public* side of the system
Anita Medendorp- van der Molen	Expert on DRT and able to provide a perspective from the *private* side of the system
Liselotte Bingen	Expert on transport innovations and the demand for DRT
Anonymous	Expert on the Wmo-indicating process and able to provide a social perspective

Table 2: Reason for selection interviewees.

Results

The result section will provide answers to the three sub-questions. This thesis will do that by combining interview results with cartographic studies and presenting them together. It will first explain how the bus network in Groningen functions, combined with results from the interviews. The spatial analysis will highlight the importance of good spatial planning and also helps get a better understanding of the accessibility of elderly in the province of Groningen. After the spatial analysis, this thesis will go deeper into what is needed to keep elderly accessible in the province of Groningen, such as good training for elderly and an economic incentive to use public transport more often.

Bus network in Groningen

The public transport in Groningen is organized in two different ways; Openbaar Vervoer and Publiek Vervoer. Openbaar Vervoer can be translated as public transport (trains and buses), while the 'Publiek Vervoer' focuses on people who require transport and is therefore not a public service but DRT. Both services make the network very dense and thus a close-knit network. Every elderly has the opportunity to be picked up at home and travel to a nearby destination or the nearest hub facility. This service is called the Wmo-Taxi or hub-taxi, whereas the hub-taxi only brings travellers to the nearest hub.

Wmo stands for 'Wet Maatschappelijke ondersteuning' and can be translated as a social support act. According to the Dutch government, municipalities have a responsibility to support people who are not self-reliant (Rijksoverheid, n.d.).

The hubs in Groningen are places where travellers can transfer from one mode of transport to another. Furthermore, travellers have access to facilities to wait comfortably at hubs. Extra services make the hub an 'enjoyable place' (Reisviahub.nl, n.d.). The function of the hubs is also addressed by interviewees 2. They mention that the hubs function well, and the bus lines towards the city of Groningen drive frequently. However, getting to the hub facility is the biggest challenge, according to them. Hubs would function better for elderly if they are easily accessible. However, the only option for elderly is the bus when they are unable to reach such hubs by car or bicycle. The Public Transport buses do not go far enough into the neighbourhood to serve all elderly. Not going far into neighbourhoods makes sense from an economic point of view for the bus providers, as there are only a small amount people to serve in small villages. Going into neighbourhoods does make lines longer and thus less cost-efficient. To compensate for the line stretching, the province of Groningen created the network of both hub-taxis and Wmo-taxis that help to bring elderly (and other groups in need of services) to their destination of the nearest hub. The service level depends on whether or not someone needs social support. The province of Groningen and the province of Drenthe reorganised the network to an efficient network where buses do not drive back empty as often as before, according to interviewee 3. That is when the 'Publiek Vervoer' organisation was established, with the primary goal to make public transport more efficient by combining different services and working in larger areas. The province's goal is to have a network where people can go from A to B with the least amount of transfers possible. That said, the larger villages around Groningen are often

directly and frequently connected with the major hospitals in the city of Groningen. On the other hand, not living close to a direct and frequent connection makes travelling much more difficult.

Spatial analysis of accessibility

The spatial analysis helps to see which areas are vulnerable to elderly. The analysis will provide insights into the vulnerability of areas where the bus stops are further away or the services such as pharmacies are at a significant distance. Before looking at walking distances and services, it is helpful first to have an overview of the neighbourhoods with high shares of elderly.

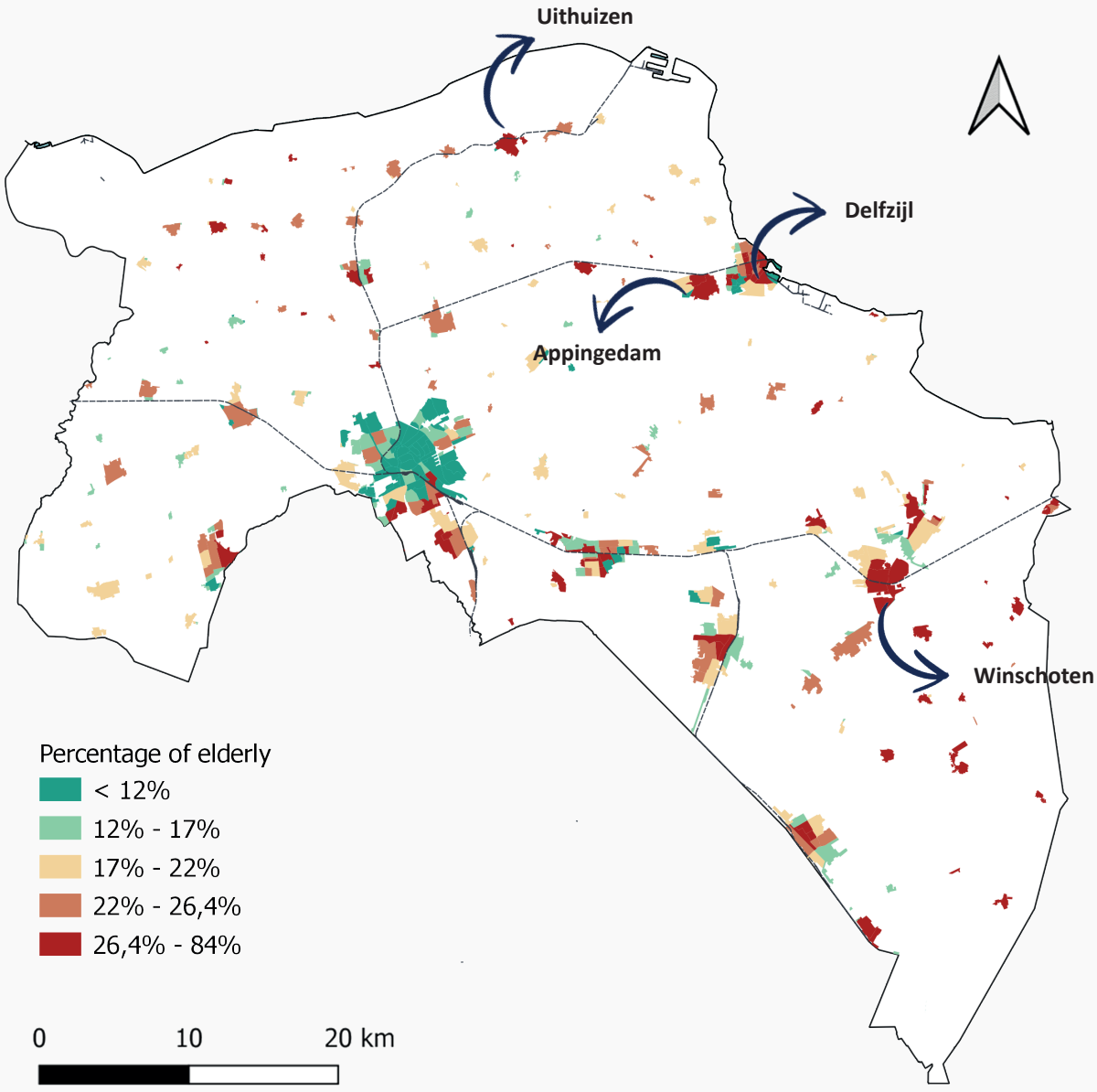


Figure 17: percentage of elderly in neighbourhoods in the province of Groningen (CBS, 2019).

Figure 17 illustrates the percentage of elderly in neighbourhoods in the province of Groningen. The city of Groningen has a lower share of elderly (65+), mainly due to the high number of students living in the city. The low share of elderly, in combination with the high density, makes public transport much easier to exploit. Further east from the city of Groningen, the share of elderly is higher. Especially the small villages in the southeast of the province are vulnerable as they are often too small to have facilities and lack frequent bus lines to bring them to facilities. As young families leave small villages to move towards the city of Groningen or other places with facilities (the small cities and large villages), the financial foundation for public transport falls away. These villages are thus more dependent on DRT as facilities and public transport disappear. Also, the small cities and large villages have high shares of elderly, especially in the east of the province. Small cities and large villages such as Uithuizen, Appingedam, Delfzijl and Winschoten have a regional function and still have services such as a pharmacy or a GP. The small villages around these small cities and large villages are thus mainly focused on them.

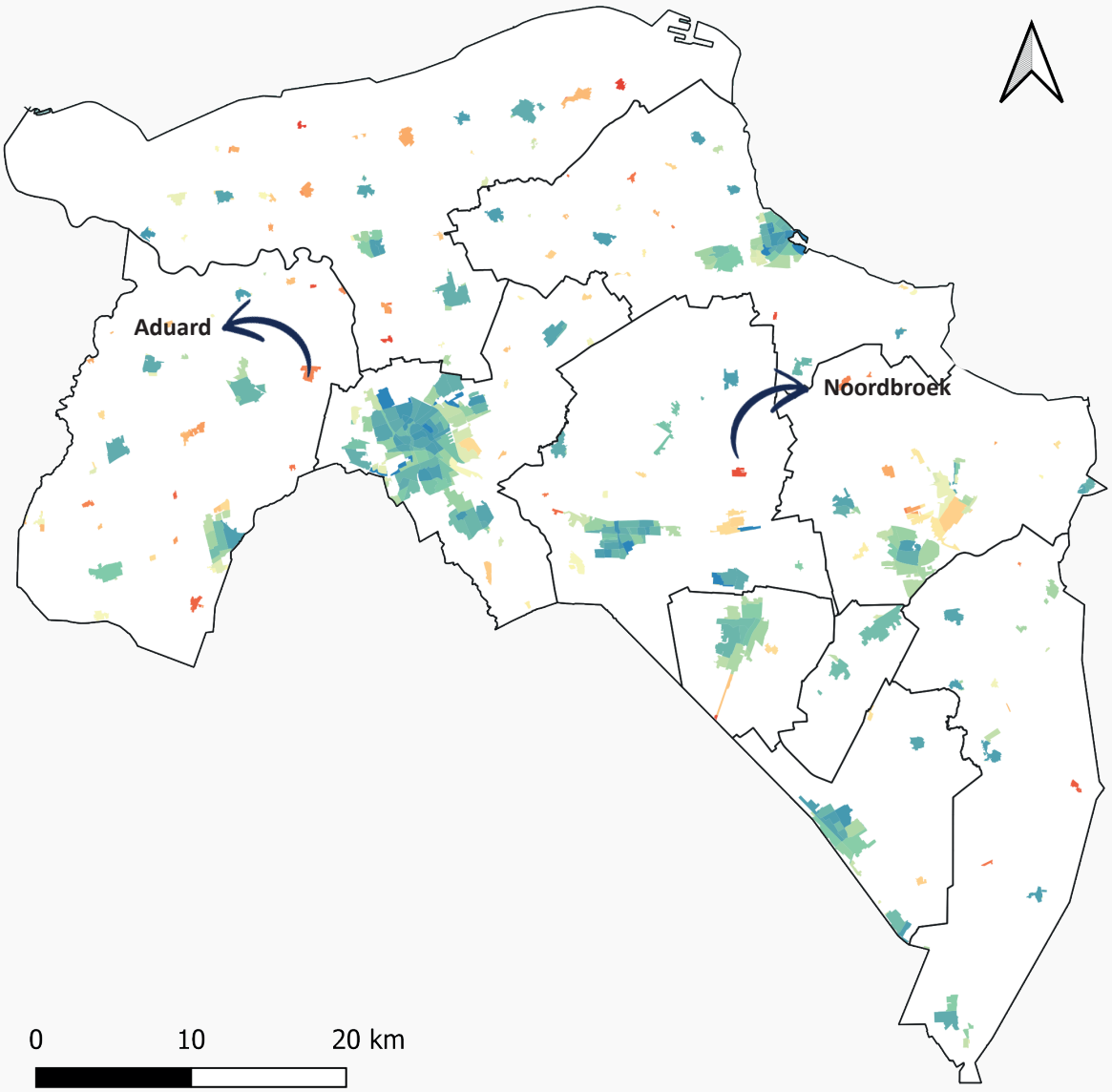


*Figure 18: Distances to pharmacies (from **blue** - short distance to **red** - large distance) (CBS, 2019)*

As can be seen in figure 18, the distance to the pharmacies is, in most areas, relatively short. Pharmacies are more focused on an elderly target group and are more often than other facilities located in less populated areas. The colours on the map go from blue (short distance) to red (large distance). The general trend is that small villages have a large distance to pharmacies and thus depend on public transport, DRT or delivery services. Examples are Noordbroek in the municipality of Midden-Groningen and Aduard in Westerkwartier. However, although they both have large distances to a pharmacy, their accessibility differs. The paragraph 'Technology and innovations' will go deeper into what trends and technologies could help to serve this group of elderly better. Next to the pharmacies, supermarkets, GPs and hospitals are important services for elderly. After analysing these maps, the spatial analysis will investigate the difference between distance and accessibility.

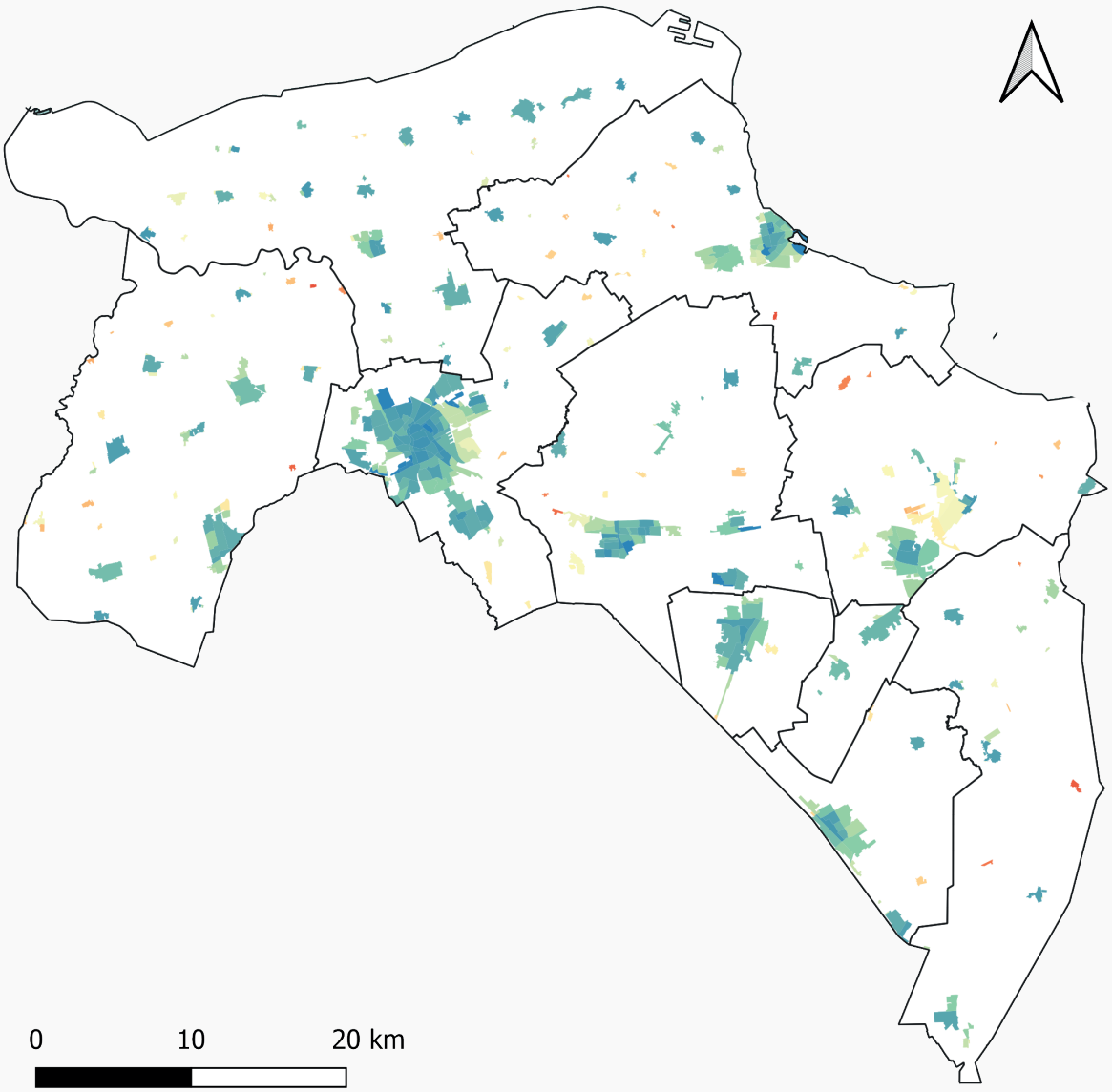


*Figure 19: Distances to GPs (from **blue** - short distance to **red** - large distance) (CBS, 2019).*

When looking at the distance to GPs (figure 19), only the really small villages have a considerable distance to a GP. The distance to GPs is relatively short as they are widely spread over the province. The small villages with large distances to GPs are also often too small to have a bus stop and thus depend on DRT to go to the GP, even if they are physically still able to take the bus. Moreover, these small villages are difficult to reach for DRT as the roads are small and often follow indirect paths. However, as no public transport is available, the only option is DRT. When using DRT, there are still two options for elderly in these villages; the Wmo-taxi and the HUB-taxi. The paragraph 'The costs of demand responsive transport and public transport' will go deeper into the differences between the modes of transport and the economic incentives for elderly.

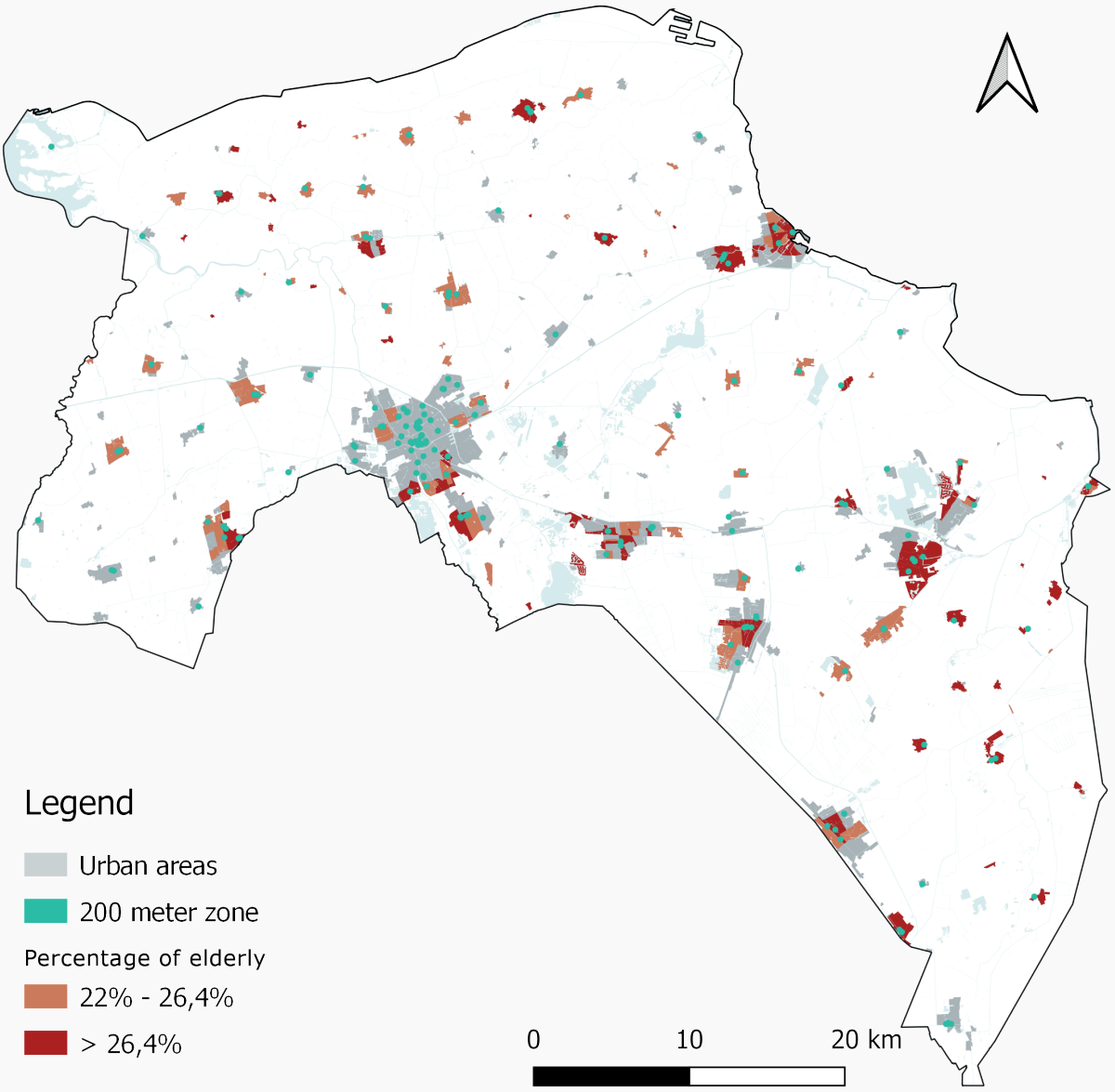


Figure 20: Map of supermarkets compared to neighbourhoods with a high share of elderly (CBS, 2019; OSM, 2022)

Figure 20 shows that many people live nearby a supermarket. This research does not see supermarkets as the main reason to take the bus as supermarkets are often very nearby. Moreover, 'noaberschap', the strong social cohesion in small communities, helps elderly to stay longer at home even when they are physically unable to walk to a supermarket, for example. However, it would be clever to house elderly nearby facilities. Still, there are neighbourhoods with large percentages of elderly with a relatively large distance to supermarkets (the red zones). It could very well be that a large percentage of elderly is still able to cycle or walk further distances to a supermarket. Nevertheless, it is also highly likely that some of the elderly in these areas depend on services to bring them to supermarkets or to get their groceries delivered at home. The challenge for the future is to house these elderly closer to daily need-facilities such as supermarkets. Attracting elderly to these locations requires a housing-concept that suits the wishes of elderly. However, this is beyond the scope of this research.

There are three hospitals in the province of Groningen, of which two are in the city of Groningen. The third hospital is in Scheemda. Going to the hospital is an important reason for travelling, according to interviewees 2. They noticed that elderly often use DRT to go to the hospitals as regular transport brings them either too late or too early for their appointment at the hospital. The same goes for appointments at the GP. According to interviewees 2, such services should be better aware of the fact that elderly are dependent on transport and thus be more flexible when making appointments. A schedule and map of the buses towards the facility should help to make public transport more attractive for elderly. If elderly know their arrival time, they can schedule appointments that will make them less dependent on DRT.

The areas with large shares of elderly and large distances to facilities will likely rely more on DRT as elderly cannot always walk to facilities. However, good public transport might be an alternative to DRT if elderly feel comfortable using it. The attractiveness of the walk towards the bus stop and the easiness of using it could stimulate using public transport.

The attractiveness of the last mile

This part of the result section mainly focuses on elderly who can still walk to the bus. The theoretical framework gave insights in the factors that influence the likeliness to travel. One of the factors was the walking distance to bus stops. The walking distance was often underestimated by elderly, which could be solved with better signs. Having better signs also touches upon the most important critique of interviewees 2: much can be done in terms of marketing and helping people get familiar with the bus network.

As the theoretical framework explained, the proximity to services could best be explained by looking at the walking distance and not time, as going to the bus stop for elderly is about the actual effort they have to deliver, not the time it takes. The theoretical framework showed that a 200-meter border is most suitable to analyse the attractiveness of the last mile. In figure 21, this research shows that many people inside small cities and villages live outside this 200-meter border. It is easier to run more lines in large cities; thus, more people will be closer to bus stops. Besides, due to the higher density, services and shops are often nearby, and there is thus not always an urge to use the bus.

Nevertheless, a lower density and an older population will create a larger walking distance to bus stops in the smaller villages. Moreover, facilities are further away, and there is thus more demand from elderly for DRT.

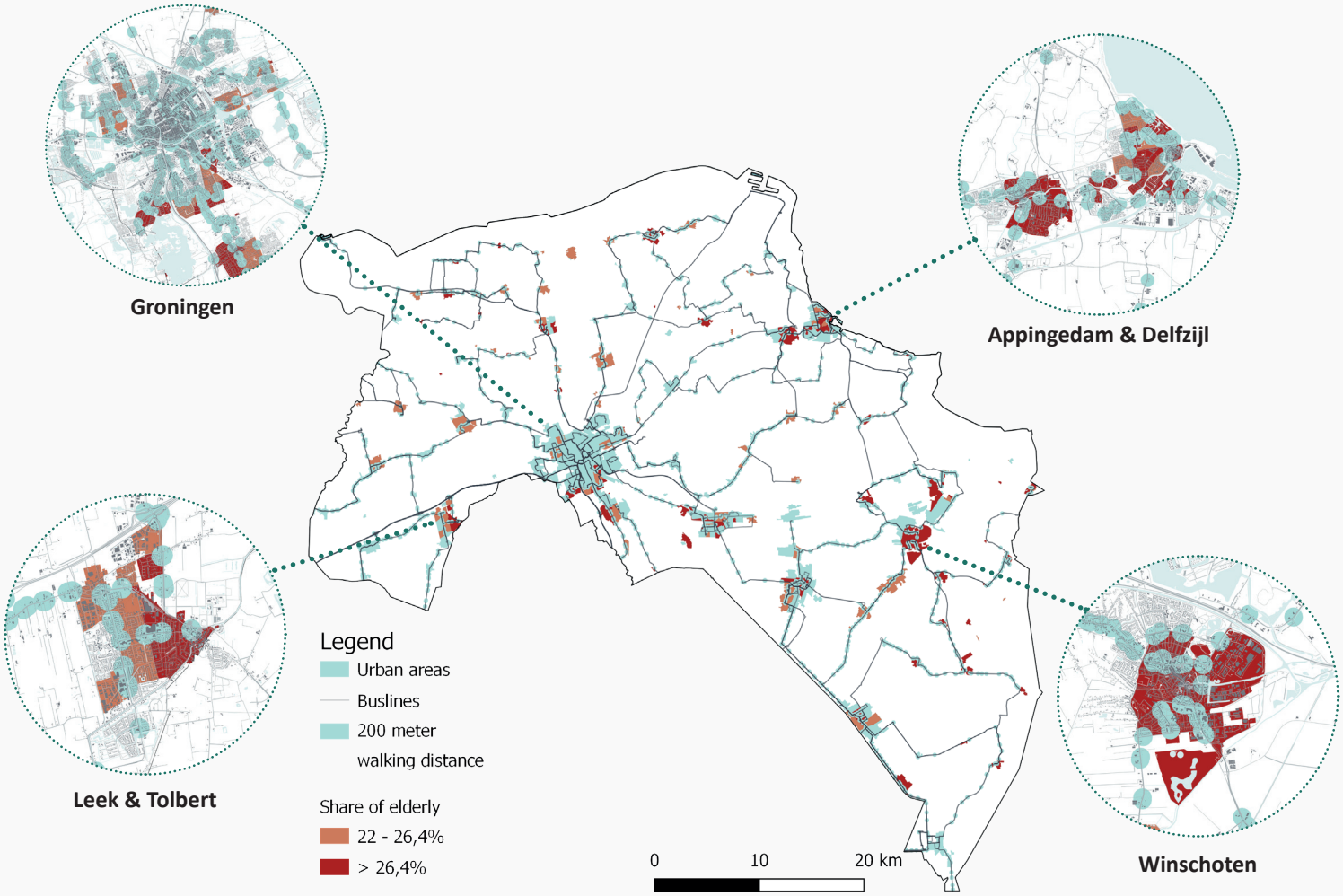


Figure 21: A buffer zone of 200 meter compared to neighbourhoods with a high share of elderly (OSM, n.d.(edited))

The red and orange coloured areas are thus places where the demand for DRT will likely be higher. The areas that are light blue either have a low share of elderly or have a short walking distance to the bus stop. The map shows that mainly the small cities and large villages have a large share of elderly and often a large walking distance to a bus stop. This research highlighted three villages to compare them to a large city like Groningen, as an example. It shows why distinguishing between different densities is necessary to assess the network better. Small cities and large villages in the province of Groningen often have a large share of elderly as they attract elderly from small villages and simultaneously lose young citizens to cities like Groningen. Secondly, they are often not dense enough to have a close-knit bus network. Although the services might often be nearby, not all trips are made towards services. According to interviewee 5, most trips are made because of leisure activities. Living nearby services thus does not reduces the dependency on DRT completely. Secondly, if one of the members of an elderly household goes to an elderly care facility, the other one is likely to travel to the facility to visit the partner frequently. The places where the bus stop is further away are likely to be places where the demand for DRT will be more significant. The likeliness of elderly to use public transport within the 200-meter zone

is hugely dependent on the quality of the walk towards the bus stop and the way elderly are familiar with using PT. The walk towards a bus stop is attractive for elderly when there is a separate footpath, a flat surface and good facilities at the bus stop itself. When travelling in dark hours, good lighting is essential for safety and to make the footpath more visible. Moreover, elderly are probably more likely to use public transport if the bus travels frequently. The bus stops in the small villages are often bus stops where a bus travels only once an hour or where the bus needs to be reserved. Also, the small cities and large villages have large parts of the city / village where there is a high share of elderly and a relatively large distance for elderly towards the bus stop. They are thus more dependent on DRT for long-distance travel to, for example, the hospital.

Another critical aspect influencing the likeliness of elderly to take the bus is the travel frequency of a bus. If a bus passes more than once an hour, it is tempting to undertake spontaneous trips. Moreover, as explained earlier, going to a GP might be plannable, but the trip back home is often not. If travellers miss a bus that drives once an hour, it will make them more likely to use DRT the next time. Therefore, it is helpful to look at the frequency of buses when looking at the vulnerability of areas for DRT.

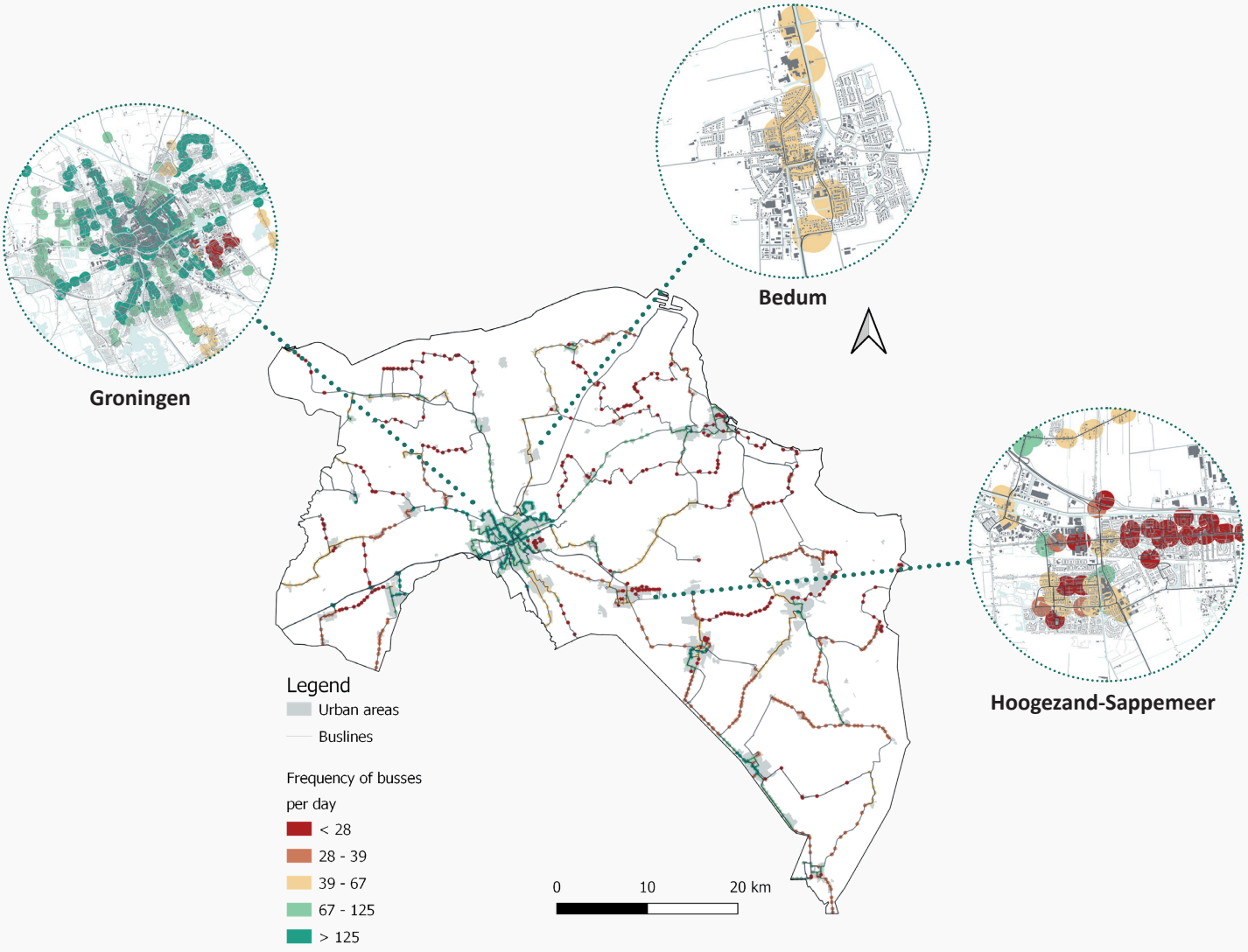


Figure 22: Frequency of buses per bus stop (OSM, n.d. (edited))

What becomes clear from figure 22 is that many bus stops outside the city of Groningen have a low frequency of buses. The expectation is that elderly who live in regions where the bus is not travelling frequently are more demanding on DRT. Figure 20 shows three 'small cities and large villages' where there are large shares of elderly and the walking distance is often (too) big. Hoogezand-Sappemeer can also be seen as such a city and has significant differences in the frequency of buses. The walking distance to a bus stop might be short sometimes, but the bus frequency still makes it less attractive to use public transport.

The attractiveness of using public transport differs for the different degrees of urbanisation. Although small cities and large villages and small villages often have some form of public transport, the large walking distance and low frequency make it less attractive to use, which will have consequences for the demand of elderly on DRT.

The demand for demand-responsive transport

Liselotte Bingen, Policy advisor on innovation at the Ministry of Infrastructure and Water Management, researched for Publiek Vervoer the expected demand of elderly in 2021. The research first estimated the number of people that will be living in the province of Groningen. The data was from research of 2016 and estimated that 1,2 million people have a 'mobility handicap'. The amount is a maximum estimation for the number of people that need a Wmo-indication. However, better technology and innovations could have a decreasing effect on the need for Wmo-indications. The research mentions research done by Goudappel (2020), which expects the travel demand to grow for DRT and the costs to rise. The interviewees also confirm this statement in this research. The Wmo costs municipalities a large amount of money. Approximately a third of this budget goes to DRT. Moreover, the research by Goudappel (2020) states that travel demand will grow due to ageing, people living longer at home, and stretching the bus lines.

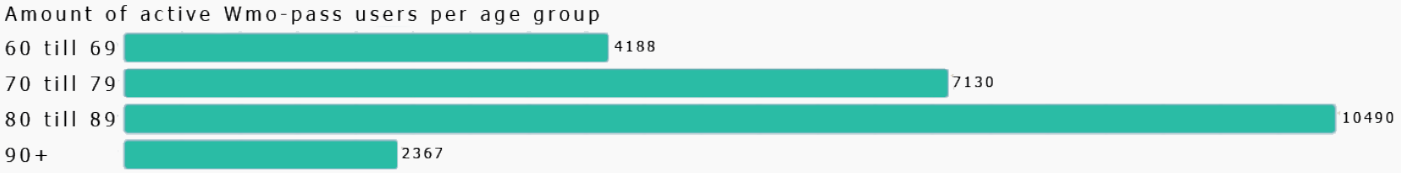


Figure 23: Amount of active Wmo-pass users per age group (Bingen, 2021 (edited for this research))

Figure 23 indicates that most Wmo-pass users are in the age group 80 to 89. The same age pattern is also visible when looking at the number of trips taken per age group (Bingen, 2021). Although the average amount of trips per pass decreases when getting older, the group is still the largest user of the pass. On average, the age group of 80 to 89 takes 29 trips a year, while the 70-79 age group takes 35 trips a year on average. Bingen (2021) shows that the municipalities of Westerwolde and Stadskanaal have the lowest average amount of trips taken per year. The low amount of trips could be due to the high share of elderly in these municipalities. Bingen (2021) also looked at the share of pass holders as opposed to the number of inhabitants in the municipality. When comparing this data from 2019 with the share of elderly in a municipality in 2019 (CBS Statline, 2022), it becomes clear that the share of elderly receiving a pass differs hugely between the municipalities in the province of Groningen, as can be seen in table 3.

Municipalities	% 65+	% Wmo-pass vs inhabitants	% of elderly receiving a Wmo pass
Appingedam	24.7%	5.2%	21%
Delfzijl	25.0%	3.7%	15%
Groningen (municipality)	14.4%	2.4%	17%
Het Hogeland	23.0%	3.4%	15%
Loppersum	22.1%	3.0%	14%
Midden-Groningen	21.8%	3.3%	15%
Oldambt	24.3%	4.7%	19%
Pekela	22.6%	3.2%	14%
Stadskanaal	24.9%	2.9%	12%
Veendam	22.5%	2.7%	12%
Westerkwartier	20.3%	3.1%	15%
Westerwolde	26.1%	2.5%	10%

Table 3: Differences in Wmo-indications per municipality

Especially the municipality of Appingedam (currently part of the municipality of Eemsdelta) and Oldambt have a high share of active pass holders. Although Westerwolde has the highest share of elderly and one of the highest shares of people in the age group of 80+, they have the lowest share of active pass holders. It seems like Westerwolde is very strict in allocating Wmo-indications, while Appingedam and Oldambt are relatively mild. Comparing the share of pass holders to the share of elderly in the age group of 85+ gives similar results.

The research by Bingen (2021) expects a growth of 69% in trips from 2019 to 2030 in the age group 80 to 89. The demand for the age group 70 till 79 is expected to grow around 45%, mainly due to the growth caused by ageing.

Municipality	2020	2030	Δ 2020-2030
Appingedam	3.000	3.700	23%
Delfzijl	6.200	6.600	6%
Groningen (gemeente)	35.000	47.200	35%
Het Hogeland	11.700	14.300	22%
Loppersum	2.200	2.700	23%
Midden-Groningen	13.400	15.700	17%
Oldambt	9.300	10.400	12%
Pekela	2.800	3.200	14%
Stadskanaal	8.000	9.200	15%
Veendam	6.200	7.200	16%
Westerkwartier	12.800	16.000	25%
Westerwolde	6.200	7.400	19%

Table 4: Expected growth of people in the age group of 65 and above (CBS Statline, 2019)

The expected growth of elderly (table 4) shows the importance of rethinking the Wmo-indication process and how we house elderly. If the same share of elderly will get a Wmo-pass in the future (2030), the financial stability of DRT might be affected. Moreover, it highlights the need to make public transport more attractive for elderly.

How do elderly get familiar with the transport system?

Getting elderly more familiar with the transport system is a multi-dimensional challenge. It is about getting elderly to use public transport more easily, and if elderly are unable to, due to a disability, getting them to use DRT. Both transport systems have to deal with the anxiety of elderly to make use of the mode of transport. The anxiety about using public transport is one of the current transport problems elderly have to deal with. Although many interviewees highlight that all modes of transport are user-friendly, elderly are still anxious to use the bus and train. Interviewees 2 mention that “elderly are often anxious to make mistakes”. An example they use is checking in; what if I check in for the wrong transport provider? Elderly, according to interviewees 2, do not have much trouble with travelling in general. The route can be found either online or at the train and bus station. However, they lack knowledge and training on what to do next when something changes during the trip. A close look at an app teaches most travellers the issue and how to continue their journey. For elderly, this is much more difficult. This problem mainly occurs using public transport. DRT is often far more personal than public transport, which makes it easier for elderly to contact a staff member. Interviewees 2 mention that for elderly, asking staff members of the transport company to help them often feels like they are a burden to the staff and their fellow travellers. With DRT, their anxiety is most often about the time of arrival of the bus and if they can make their transfer or pre-scheduled appointment at the hospital. All these situations that could happen during a journey reduce the likeliness of elderly to use public transport. The lack of confidence in using public- and demand-responsive transport is why Publiek Vervoer wants to continue with the public transport ambassadors to boost the confidence of elderly. By taking elderly on a guided trip, the ambassadors can show elderly how public transport works and where they need to be in case something goes wrong. Nevertheless, ambassadors are volunteers and do thus not have unlimited time and resources to convince elderly to use public transport. To be more efficient, the ambassadors try to host education sessions in elderly care homes, for example, to show how public transport works.

However, the response to those educational sessions is still low. Next to the educational sessions, they sometimes have open walk-in hours for elderly to ask questions, but the response is also low. The ambassadors feel little support from municipalities, although this differs per municipality.

Figure 24: A walk-in hour for elderly to get to learn more about public transport (Source: Lex van Rootselaar)

The costs of demand-responsive transport and public transport

There is a significant difference between the cost of public transport and DRT. Interviewee 3 mentions that "one kilometre with DRT is ten times more expensive as one kilometre with public transport". The need to stimulate elderly to use public transport is thus significant from an economic point of view. However, the costs of public transport are for the public transport organisation (Qbuzz in the province of Groningen), while the costs of DRT are for the municipalities. The municipalities have a Wmo-budget of which a large share goes to transport. Public transport organisations are thus not inclined to adjust their lines to go deeper into the neighbourhoods and make it more attractive for elderly, as the distance to the bus will decrease. The public transport organisations do not feel the negative economic effects of the high costs of DRT. The hub-taxi is the public transport equivalent of the Wmo-taxi and also functions as DRT. The costs for the hub-taxi are thus for the public transport organisations and not the municipalities. The other difference is that the hub-taxi brings travellers to and from the nearest hub. The vehicle and driver are the same as the Wmo-taxi, but the costs and functioning differ according to interviewee 3. However, the hub-taxi lacks publicity as it has only been established recently. Secondly, the hub-taxi is more expensive for elderly than the Wmo-taxi. Elderly pay a contribution for the Wmo-taxi that is equal to the price of public transport. The equal price is also immediately the most significant sore point. Elderly can get a transfer from A to B, for the same price as public transport, which only brings them to and from the bus stop. The costs for elderly are thus the same, while this is not the case behind the scenes. The costs are ten times as high and, for the biggest part, all for the municipality. Elderly being more familiar with the public transport system and the hub-taxi would thus benefit the municipalities. As some interviewees state, the Wmo-taxi will be too expensive in the long term, resulting in more costs for elderly or a less functioning service. The municipalities thus need to look at how they give elderly a Wmo-indication. Several interviewees mentioned that not every elderly needs the same budget for the Wmo-taxi. Differentiation in the budgets per person could save money, according to them. Interviewee 6 mentions that Wmo-consultants often have a high workload and thus give elderly a Wmo-pass more easily than sometimes needed. Moreover, they often do not see municipalities' massive transport costs and do not consider that. A solution could be to make these employees better aware of the costs and spend more time differentiating budgets. Not every elderly needs the same budget for transport. Interviewee 4 mentions that they sometimes transport elderly who are maybe wrongly indicated by a Wmo-consultant. She states that money can be saved when elderly are assessed for a Wmo-indication with more care. However, these elderly have a Wmo-pass and will thus use the taxi as it costs the same amount of money as the bus. The operator also sees significant differences between the municipalities, as table 2 also highlights. Some municipalities are very strict, while others are mild in assigning Wmo-passes. Municipalities often struggle to find enough employees or do not have the resources to hire new ones. Nevertheless, more employees might save municipalities money as better differentiation between elderly can be made. Additionally, one of the solutions mentioned was to give better education about how public transport works instead of immediately giving someone the standard amount of kilometres for a Wmo-taxi.

All the ideas and comments about making public transport more attractive for elderly only work when there is a financial incentive. Even when elderly know how to use public transport, it is still less attractive than being brought in a van from door to door, especially in bad weather, as the interviewee 3 mentions. The number of trips of less than three kilometres strongly increases during bad weather. One of the experiments that could help to tempt elderly to use public transport instead of DRT is to give them free public transport. This financial motivation might make public transport more attractive. If this financial incentive works, it is up to the organisations and municipalities to educate elderly on how public transport works, make the last mile more attractive, and house elderly at nearby facilities or bus stops. Giving elderly free public transport is expensive for municipalities. However, it might save money if it replaces a large sum of the Wmo-taxi trips. Some regions are now experimenting with free public transport for elderly, but the outcomes are not yet available. One of the outcomes could be that elderly see the free public transport as complementary to the Wmo-taxi and travel more than before. In that case, free public transport might not work, although it could benefit their Social Connectedness. If it does not work, another solution could be to differentiate more between elderly and their level of mobility. Some of elderly might still be mobile enough to be helped with free public transport instead of the Wmo-taxi. Elderly can use the hub-taxi to get from their house to the nearest hub when necessary. As mentioned before, Wmo-consultants need to be aware of the functioning of public transport and DRT to make the proper assessment per person. Moreover, to decrease the costs of the Wmo-taxi, a system is needed where the driver can easily pick up other customers to maintain a high occupancy rate. Modern apps could help make this easier.

Technology and innovations

One part of this research is assessing the current situation and looking at the future. Many interviewees address that elderly of 2030 will be much more familiar with apps, which will help them to use public transport more accessible. If elderly use apps, organisations collect much more data about travel behaviour. Secondly, apps such as MaaS (Mobility as a Service) can help to better combine different forms and modes of transport in one app. MaaS is one digital app or service for all types of transport, adjusted to personal needs (Mobility Concept, n.d.). The data required by apps can also help better adjust the Wmo-indication to what people need. To make sure elderly of 2030 are familiar with apps, organisations should now invest in educating them, according to interviewees 3 and 5. Interviewee 5 mentions that the integration of DRT is still problematic in some regions. The app could integrate the hub-taxi, for example, when elderly seek information on their app. Based on their wishes, being picked up, for example, elderly get adjusted travel advice.

Not only can technology help to let elderly travel easier, but it could also prevent the need to travel. Drones could bring medication, while robots could function as extra social contacts in health care homes. At the beginning of this research, this research assessed four different scenarios for future autonomous driving. However, some interviewees mention that a driver also often functions as social contact and makes transport more personal. These are functions that cannot be replaced easily by technology. Interviewee 1 mentions that, when talking about the Wmo-taxi, the driver is not just the driver of a taxi but also a guide and companion.

Conclusion

This research has as the primary research question to investigate what is needed in terms of accessibility in the province of Groningen to keep elderly participating in tomorrow's society. By doing spatial analysis and interviewing a broad range of experts, this research has created a better understanding of how the current network works, what the problems are with the current network, and what organisations and institutions could do, now and in the future.

In the first part of the result section, the spatial maps introduced the reason for what will likely result in an unsustainable transport network for elderly in the future. Large shares of elderly live in rural areas with large distances to facilities and bus stops. Therefore, they are dependent on DRT. The increasing ageing in these regions will make DRT more challenging to exploit as it is ten times more expensive than public transport. Elderly that are currently in need of transport, as they cannot drive or go by bicycle, face a public transport network designed to transport a large number of customers as efficiently as possible. Elderly often find it challenging to deal with the uncertainty of travelling in public transport modes. Moreover, especially in more rural areas, travelling by bus is often very slow, and the buses have a low frequency. The schedule often does not meet their demands. Better information supply and education could be helpful to get more of elderly into public transport instead of the DRT. The information supply should focus on both the customer and elderly and services that plan appointments with elderly.

The second problem follows the increased demand that DRT will face due to the increased ageing. The demand should either be reduced, or DRT should be arranged differently to keep DRT sustainable in the future. A proposed scheduling strategy helps to arrange DRT differently. The strategy would help to increase the occupancy rate by preventing vans from only driving with a limited number of passengers. One way of reducing the demand for DRT is to increase the attractiveness of public transport. Elderly should be informed and trained better to be more inclined to use public transport. Moreover, public transport could be more attractive if elderly live closer to frequent bus stops. However, elderly will only use public transport if there is an economic incentive. As long as this incentive is not there, DRT will likely be more attractive as it is more private and brings travellers from door to door, other than public transport, where they still have to walk to a bus stop. Although walking to a bus stop could be a plus due to the physical activity, the weather and attractiveness of the last mile influence the likeliness of using public transport. Finally, the hub-taxi can help to convince elderly who live further away from bus stops or have more trouble walking to a bus stop to use public transport. A different form of indicating could also reduce the demand.

Currently, there are many differences between municipalities in terms of Wmo-indications. Appingedam and Oldambt are generous in giving Wmo-indications, while Westerwolde seems quite strict. Moreover, elderly who do not yet need DRT sometimes receive a Wmo-indication, while they are still able to use public transport. As DRT is ten times as expensive as regular public transport, it would economically be more feasible if elderly, who can still use other modes of transport, do not get a financial incentive to use DRT. Better education for Wmo-consultants on the effects of their decisions on the transport budgets of municipalities could help to reduce the amount of elderly who have an economic

incentive to use DRT. Secondly, it could help to differentiate more in the number of kilometres a person gets. Not every elderly needs the same amount of kilometres in their budget. Due to municipalities being understaffed, Wmo-consultants often do not have the time to differentiate between persons or to look more closely if someone needs a Wmo-pass. However, the choices made there could save the municipalities more money in the future and helps to keep DRT sustainable.

Elderly of 2030 will likely be more familiar with smartphones. Being more acquainted with smartphones and thus apps also helps to give elderly better trip advice. Secondly, elderly being able to use a smartphone more will also likely decrease their insecurity when using public transport. Finally, MaaS could help to make public transport and DRT easier to view in one app. The data from these apps could help municipalities get more insights into the travel demand of elderly. The action points to create a sustainable mobility network in the province of Groningen can thus be summarised as:

Five steps to a more sustainable mobility network

1. Reduce the travel demand and travel frequency of elderly by good spatial planning

2. Boost the confidence of elderly to use public transport. This could be done by trainings and better information supply. More volunteers are needed. Invest in making the elderly of 2030 more familiar with apps.

3. Reduce the demand for Demand Responsive Transport by re-evaluating the Wmo indicating process

4. Use clever apps to implement a proposed scheduling strategy in Demand Responsive Transport

5. Create an economic incentive for elderly to make public transport more attractive

This research, in the end, reflected on the state of the network, highlighted the current and future problems regarding the accessibility of elderly in the province of Groningen, and advised on several changes. The research showed that the system needs changes to keep elderly participating in society today and in 2030. Although the network of both public transport and DRT is close-knit, the network's economic stability will get more and more complex over the years when not making these changes.

Discussion

This section will examine the results' meaning, importance, and relevance. The results of this thesis highlight the urgency to look at the accessibility of elderly as socially relevant and not look at it from an economic perspective. Creating better accessibility for elderly leads to elderly better contributing to today's society and making them less dependent on their surroundings, which leads to better social connectedness and better independent living, which are healthy ageing indicators. Especially the independent living parameter (elderly over 75 living independent) is under pressure as the financial stability of the mobility network in the province of Groningen will be hard to maintain as the ageing makes public- and demand-responsive transport more expensive. The problems highlighted in this thesis could thus have significant consequences if not dealt with properly. Governments need to think more about the accessibility of elderly when stimulating elderly to stay at home as long as possible. This policy has the benefit that elderly live as long as possible in a trusted and familiar environment, but as a downside, they have a growing dependency on mobility services. The results of this thesis can help get insight into the spatial characteristics of different urban areas regarding distance to facilities and public transport. However, it also gives qualitative insights into the problems concerning Wmo-indications, the current DRT system, and how elderly experience public transport. The conclusions of this thesis are relevant for the province of Groningen, the municipalities in the province and transport organisations. Moreover, the results are just as relevant for the province of Drenthe, as they have the same mobility system and have almost similar spatial characteristics as Groningen. Lessons learned on the functioning of the mobility system in the province of Groningen and Drenthe can be relevant for other regions in the Netherlands that face an increasingly ageing population.

A follow-up on this research could be a more detailed analysis of municipalities to see what areas are more vulnerable for elderly regarding distances to facilities and bus stops and take that into account in their housing plans. Currently, housing plans often go by on the proximity of facilities for elderly. Moreover, within a city, we often do not consider walking distances when planning housing for elderly. Secondly, it would be relevant to do more extensive research on how elderly experience public transport and DRT. This research tried to gain insights into the travel demand of elderly by doing interviews. However, a more extensive analysis is necessary, both qualitative and quantitative, to adjust public- and demand-responsive transport better to the needs of elderly. Unfortunately, the results of a pilot with free public transport cannot be considered in this research as the pilot is not finished yet. It would be valuable to investigate whether or not elderly substitute trips with DRT for public transport or whether elderly would see these free trips as an incentive to travel more. Both could have positive outcomes. Substituting trips could hopefully reduce the costs of DRT, although this needs further research, while extra trips with public transport could contribute to the participation in the society of elderly and thus reduce loneliness. Finally, governments and organisations need to invest more in apps to bring several modes of transport together in one app that gives travel advice based on personal preferences such as maximum walking distance, amount of transfers and costs, for example. Further research could monitor how elderly can be better educated with apps and how their fear of public transport could be reduced.

The qualitative research lacked the input of the 'OV Bureau Groningen Drenthe', the overarching public transport organisation in the province of Groningen and Drenthe. Their input and vision are essential in creating research that considers different perspectives from different organisations and thus creates a holistic picture of the situation. Moreover, more interviews with different Wmo-consultants of the different municipalities in the province of Groningen could have helped better understand the Wmo-indication process. Research on this process and its impacts on other domains within municipalities could help get better insights into the effects of choices within this indicating process. Nevertheless, this research had a broad perspective of interviewees and combined this with spatial analysis to get a holistic overview of the situation. Although this research took more time than planned, it did not affect the outcomes. Due to the delayed process, this research had more time to contact the right interviewees.

This research, in the end, hopes to contribute to the debate in provinces, municipalities and organisations arranging mobility in the province of Groningen. Furthermore, it hopes to create more attention for elderly and their increasing loneliness.

Bibliography

Abe, R. (2021) “Preferences of Urban Rail Users for First- and Last-Mile Autonomous Vehicles: Price and Service Elasticities of Demand in a Multimodal Environment,” Transportation Research Part C, 126. doi: 10.1016/j.trc.2021.103105.

Ammons, D. N. (2001). Municipal benchmarks : assessing local performance and establishing community standards. 2nd edn. Thousand Oaks, Calif.: Sage Publications.

Böcker L., van Amen, P. and Helbich, M. (2017). “Elderly Travel Frequencies and Transport Mode Choices in Greater Rotterdam, the Netherlands,” Transportation : Planning - Policy - Research - Practice, 44(4), pp. 831–852. doi: 10.1007/s11116-016-9680-z.

Bogart, N. (2020). Finding it hard to work from home? You might want to consider a fake commute. Retrieved on July 5, 2022 from https://www.ctvnews.ca/health/coronavirus/finding-it-hard-to-work-from-home-you-might-want-to-consider-a-fake-commute-1.5161352. Canada: CTV News.

Borst, H. C., de Vries, S. I., Graham, J. M. A., van Dongen, J. E. F., Bakker, I., & Miedema, H. M. E. (2009). Influence of environmental street characteristics on walking route choice of elderly people. Journal of Environmental Psychology, 29(4), 477–484. https://doi.org/10.1016/j.jenvp.2009.08.002

CBS (2019). CBS Wijken en Buurten 2019 versie 3 WMS. Available at: https://www.nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/metadata/3ac5737f-55ed-455d-8350-44af11b67fc3

CBS (2020). Ouderen. Retrieved on December 15, 2021 from https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/leeftijd/ouderen

CBS Statine (a) (2021). Mobiliteitstrend; per rit, vervoerwijzen, reismotief, leeftijd en geslacht. Retrieved on December 25, 2021 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/84755NED/table?ts=1640429431462

CBS Statline (2019). Regionale prognose 2020-2050; bevolking, intervallen, regio-indeling 2018. Retrieved on June 6, 2022 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/84527NED/table?ts=1655144900414

CBS Statline (2022). Regionale kerncijfers Nederland. Retrieved on April 29, 2022 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/70072ned/table?ts=1651403993341

CBS Statline (b) (2021). Overledenen; doden door verkeersongeval in Nederland, wijze van deelname. Retrieved on December 25, 2021 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/71936ned/table?ts=1640433632445

CBS Statline (c) (2021). Levensverwachting; geslacht, leeftijd (per jaar en periode van vijf jaren). Retrieved on January 5, 2022 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37360ned/table?fromstatweb

CBS Statline (d) (2021). Huishoudens; samenstelling, grootte, regio, 1 januari. Retrieved on August 1, 2022 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/71486ned/table?dl=6C54D

CBS Statline (e) (2021). Bevolkingsontwikkeling; levend geborenen, overledenen en migratie per regio. Retrieved on August 1, 2022 from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37259ned/table?dl=6C54E

Chikaraishi, M., Fujiwara, A., Tanaka, K., Junyi Zhang, J. (2011). Measuring Social Exclusion based on expansion of space of activity and amount of social contact [Katsudo Kukan no Hirogari oyobi Shakaiteki Sesshoku-ryo ni motoduku Shakaiteki Haijo no Keisoku Houhou no Teian], Proceedings of infrastructure planning, Vol.43□CD-ROM.

Church, A., Frost, M. and Sullivan, K. (2000). Transport and Social Exclusion inLondon - Report Summary, London Transport Planning, London.

Collia, D. V., Sharp, J., & Giesbrecht, L. (2003). The 2001 national household travel survey: a look into the travel patterns of older americans. Journal of Safety Research, 34(4), 461–70.

Cordeau, J. and Laporte, G. (2007). "The Dial-A-Ride Problem: Models and Algorithms," Annals of Operations Research, 153(1), pp. 29–46. doi: 10.1007/s10479-007-0170-8.

CROW (2021). Inzicht in acceptabele loopafstanden. Ede: CROW-KpVV.

CROW (2022). Concessieposters Openbaar Vervoer. Retrieved on August 2, 2022 from https://www.crow.nl/kennis/bibliotheek-verkeer-en-vervoer/kennisdocumenten/concessieposters

De Buurtvlinder (n.d.). Waarom de Buurtvlinder?. Retrieved on December 27, 2021 from https://debuurtvlinder.nl/

De Stentor (2022). Woningnood dwingt jongeren tot vertrek uit geliefde dorp: 'Noodgedwongen naar de stad verhuisd'. Retrieved on August 1, 2022 from https://www.destentor.nl/wonen/woningnood-dwingt-jongeren-tot-vertrek-uit-geliefde-dorp-noodgedwongen-naar-de-stad-verhuisd~ab2d1a11/

Delfmann, H., Koster, S., McCann, P., & Van Dijk, J. (2014). Population change and new firm formation in urban and rural regions. Regional Studies: The Journal of the Regional Studies Association, 48(6), 1034–1050. https://doi.org/10.1080/00343404.2013.867430

Demetsky, M.J., Lin, B. (1982). Bus stop location and design. Transp. Eng. J. Am. Soc. Civ. Eng. 108, 313–327.

Derrible, S. & Kennedy, C. (2009). Characterizing metro networks: state, form and structure. Springer Science + Business Media, 37, pp. 275-297

Doorfietsroute.nl (n.d.). Lekker doorfietsen? Neem de Doorfietsroute!. Retrieved on December 25, 2021 from https://www.doorfietsroute.nl/

Douma, L., Steverink, N., Hutter, I., & Meijering, L. (2015). Exploring subjective well-being in older age by using participant-generated word clouds. The Gerontologist, Gnv119, 119. https://doi.org/10.1093/geront/gnv119

Elshof, H. (2017). Local population decline in rural north-netherlands. dissertation. University of Groningen.

Europa decentral (n.d.). Concessies. Retrieved on August 2, 2022 from https://europadecentraal.nl/onderwerp/aanbesteden/aanbestedingsplicht/concessies/

Gemeente Groningen (2017). Ontwerp-Nota-van-Uitgangspunten-aanbesteding-openbaar-busvervoer-Groningen-en-Drenthe-2020-2029. Available at: https://gemeenteraad.groningen.nl/Documenten/Ontwerp-Nota-van-Uitgangspunten-aanbesteding-openbaar-busvervoer-Groningen-en-Drenthe-2020-2029-1.pdf (Accessed: 2 August 2022).

Glover, L., Dyson, J., Cowdell, F., & Kinsey, D. (2020). Healthy ageing in a deprived northern uk city: a co-creation study. Health & Social Care in the Community, 28(6), 2233–2242. https://doi.org/10.1111/hsc.13036

Haartsen, T. & Venhorst, V. (2010). Planning for decline: anticipating on population decline in the Netherlands. Tijdschr. Voor Econ. En Soc. Geogr. 101 (2), 218–227. https://doi.org/10.1111/j.1467-9663.2010.00597.x

Hess, D. B. (2012). "Walking to the Bus: Perceived Versus Actual Walking Distance to Bus Stops for Older Adults," Transportation : Planning - Policy - Research - Practice, 39(2), pp. 247–266. doi: 10.1007/s11116-011-9341-1.

Heuff, E. & Leliveld, P. (2022). Woningmarktonderzoek Eemsdelta. KAW.

Hine, J. and Mitchell, F. (2016) Transport disadvantage and social exclusion : exclusionary mechanisms in transport in urban scotland. London: Routledge (Transport and society). Available at: INSERT-MISSING-URL (Accessed: 2022).

Hjorthol, R. J., Levin, L., & Sirén, A. (2010). Mobility in different generations of older persons : the development of daily travel in different cohorts in denmark, norway and sweden. Journal of Transport Geography, 18(5), 624–633. https://doi.org/10.1016/j.jtrangeo.2010.03.011

Inoi, H., Nishiwaki, M. and Doi, K. (2017). "Social Exclusion Related to Mobility in Urban Area," Transportation Research Procedia, 25, pp. 4219–4228. doi: 10.1016/j.trpro.2017.05.373.

Jokinen, J.-P., Sihvola, T. and Mladenovic, M. N. (2019). "Policy Lessons from the Flexible Transport Service Pilot Kutsuplus in the Helsinki Capital Region," Transport Policy, 76, pp. 123–133. doi: 10.1016/j.tranpol.2017.12.004.

Jokinen, J-P., Tinnilä, M., Sulonen, R. (2014). Positioning and Pricing of Urban Mass Demand Responsive Transport: Case Study of Helsinki Metropolitan Area. In: The 2nd UITP Taxi Conference, Doha, Qatar.

Jong, B. de, D'Onofrio, G., Sancarlo, D., Greco, A., de, J. B., Wynia, K., & Geluk-Bleumink, A. (2018). Ageing better in the netherlands. IntechOpen. Retrieved 2022, from http://hdl.handle.net/11370/12aae067-b66a-42ec-a7b2-1ddc72158a57.

Kaufmann, V., M. Schuler, O. Crevoisier and P. Rossel (2004) Mobilité et motilité. De l'intentionà l'action. (Mobility and motility: from intention to action) Laboratoire de sociologie urbaine,Cahier du Lasur no. 4 (Lausanne: Ecole Polytechnique Fédérale de Lausanne)

Kemperman, A. and Timmermans, H. (2014) "Green Spaces in the Direct Living Environment and Social Contacts of the Aging Population," Landscape and Urban Planning, 129, pp. 44–54. doi: 10.1016/j.landurbplan.2014.05.003.

KNMI (2021). KNMI Klimaatsignaal'21. Retrieved on July 10, 2022 from https://www.knmi.nl/kennis-en-datacentrum/achtergrond/knmi-klimaatsignaal-21

Lakatos A., Tóth, J., and Mándoki, P. (2020). "Demand Responsive Transport Service of 'dead-End Villages' in Interurban Traffic," Sustainability, 12(9), pp. 3820–3820. doi: 10.3390/su12093820.

Levine, J. (2011). Getting There: From Mobility to Accessibility in Transportation Planning. Retrieved on June 5, 2022 from https://www.resources.org/common-resources/getting-there-from-mobility-to-accessibility-in-transportation-planning/. Washington: Resources for the Future.

Levinson, H.S. (1992). Urban mass transit systems. In: Edwards, J. (ed.) Transportation Planning Handbook, pp. 123–174. Prentice-Hall, Englewood Cliffs

Li, H., Raeside, R., Chen, T., & McQuaid, R. W. (2012). "Population Ageing, Gender and the Transportation System," Research in Transportation Economics, 34(1), pp. 39–47. doi: 10.1016/j.retrec.2011.12.007.

Luiu, C., Tight, M. & Burrow, M. (2016). The unmet travel needs of the older population: a review of the literature. Transport Reviews. 1-19. 10.1080/01441647.2016.1252447.

Mobility Concept (n.d.). Mobility as a Service: één digitale dienst voor toegang tot alle vervoer afgestemd op individuele behoeftes. Retrieved on April 29, 2022 from https://www.mobilityconcept.nl/mobility-as-a-service-digitale-dienst-toegang-tot-vervoer-afgestemd-op-individuele-behoeftes/?gclid=Cj0KCQjw37iTBhCWARIsACBt1IxuHD7jOV0Mx7_60Lh7dyWLkqb7RVRe2lZOdnpZBc2kWABp2mpbkBUaAn9dEALw_wcB

Morales, J. A., Flacke, J., Morales Guarin, J. M., & Zevenbergen, J. A. (2019). Mapping urban accessibility in data scarce contexts using space syntax and location-based methods. Applied Spatial Analysis and Policy, 12(2), 205–228.

OSM (2022). OSM_Winkels. Available at: https://services.arcgis.com/nSZVuSZjHpEZZbRo/arcgis/rest/services/OSM_Winkels/FeatureServer

OSM (n.d.) OV. Available at: KAW

Osti, G. (2010) “Mobility Demands and Participation in Remote Rural Areas,” Sociologia Ruralis, 50(3), pp. 296–310. doi: 10.1111/j.1467-9523.2010.00517.x.

PBL (2022). Prognose: in 2035 vooral meer inwoners in en om grotere gemeenten. Retrieved on July 10, 2022 from https://www.pbl.nl/nieuws/2022/prognose-in-2035-vooral-meer-inwoners-in-en-om-grotere-gemeenten

PDOK (2020). Dataset: Basisregistratie Adressen en Gebouwen (BAG), data file, PDOK, viewed August 1, 2022 from https://www.pdok.nl/geo-services/-/article/basisregistratie-adressen-en-gebouwen-ba-1#8074e10f7b8333d716001c1b3a7348a3

Province of Groningen (2015). Agenda Krimpbeleid Provincie Groningen 2015-2020. Province of Groningen.

Pucher, J. and Buehler, R. (2008) “Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany,” Transport Reviews, 28(4), pp. 495–528. doi: 10.1080/01441640701806612.

Reisviahub.nl (n.d.). Wat is een hub? Retrieved on Februari 19, 2022 from reisviahub.nl

Rijksoverheid (a) (n.d.). Oorzaken en gevolgen bevolkingsdaling. Retrieved on August 1, 2022 from https://www.rijksoverheid.nl/onderwerpen/bevolkingsdaling/oorzaken-en-gevolgen-bevolkingsdaling

Rijksoverheid (b) (n.d.). Wet maatschappelijke ondersteuning (Wmo). Retrieved on July 12, 2022 from https://www.rijksoverheid.nl/onderwerpen/zorg-en-ondersteuning-thuis/wmo-2015

RIVM (n.d.). Trendscenario | Sterfte en levensverwachting. Retrieved on January 5, 2022 from https://www.volksgezondheidtoekomstverkenning.nll/

Robine, J., and Jagger, C. (2005). “The relationship between increasing life expectancy and healthy life expectancy.” Ageing Horizons 3: 14-21.

Rosenkvist, J., Risser, R., Iwarsson, S., & Ståhl, A. (2010). Exploring Mobility in Public Environments among People with Cognitive Functional Limitations-Challenges and Implications for Planning, Mobilities, 5(1), pp. 131–145.

RTV Noord (2021). Wat verandert er met de nieuwe verkeersplannen in Stad?. Retrieved on December 25, 2021 from https://www.rtvnoord.nl/nieuws/882416/wat-verandert-er-met-de-nieuwe-verkeersplannen-in-stad

Scheiner, J. (2006). Does the car make elderly people happy and mobile? Settlement structures, car availability and leisure mobility of elderly. European Journal of Transport and Infrastructure Research, 6(2). https://doi.org/10.18757/ejtir.2006.6.2.3431

Schmöcker, J.-D., Quddus, M. A., Noland, R. B., & Bell, M. G. H. (2008). Mode choice of older and disabled people: a case study of shopping trips in london. Journal of Transport Geography, 16(4), 257–267. https://doi.org/10.1016/j.jtrangeo.2007.07.002

Sociaal Planbureau Groningen (n.d.). Bevolking. Retrieved on July 10, 2022 from https://sociaalplanbureaugroningen.nl/brede-welvaart/bevolking/

Social Exclusion Unit (2003). Making the connections: final report on transport and social exclusion. http://www.socialexclusionunit.gov.uk/publications/reports/html/transportfinal/summary.

Stanley, J. and Lucas, K. (2008) "Social Exclusion: What Can Public Transport Offer?," Research in Transportation Economics, 22(1), pp. 36–40. doi: 10.1016/j.retrec.2008.05.009.

Tillema, T., Berveling, J., Gelauff, G., Waard, J. van der, Harms, L. and Derriks, H. (2015). Driver at the wheel? Self-driving vehicles and the traffic and transport system of the future. The Hague: Kennisinstituut voor Mobiliteitsbeleid.

Torkjazi, M. and Huynh, N. (2019) "Effectiveness of Dynamic Insertion Scheduling Strategy for Demand-Responsive Paratransit Vehicles Using Agent-Based Simulation," Sustainability, 11(19), pp. 5391–5391. doi: 10.3390/su11195391.

U.S. Federal Transit Administration (1996). Guidelines for the Location and Design of Bus Stops. Transit Cooperative Research Program Report No. 19. National Academy Press, Washington.

Unece (2019). II. Results. Retrieved on October 21, 2021 from https://statswiki.unece.org/display/AAI/II.+Results#expand-2018AAIbydomain

Unece (n.d.). Active Ageing Index. Retrieved on October 31, 2021 from https://unece.org/population/active-ageing-index

van Hoven, B, Brouwer, AE & Meijering, L (2012). 'Introduction: geographies of ageing and well-being', European Spatial Research and Policy, vol. 19, no. 1, pp. 9 - 15. https://doi.org/10.2478/v10105-012-0002-y

WIJ Groningen (n.d.). Vervoer en mobiliteit. Retrieved on December 27, 2021 from https://wij.groningen.nl/gezondheid-en-welzijn/vervoer-en-mobiliteit/

Appendix

Appendix A

The interview guide per theme:

General introduction

Can you tell me a little bit about your work?

To get a good picture first.... How much do you have to do with the elderly and in what way?

On elderly and ageing

What do you notice about loneliness among the elderly? And do you feel you play a positive role in it?

What are the experiences of older people in public transport now?

What problems do you foresee for older people in the next 10 to 20 years as the ageing of the population increases?

What problems are there for the province then?

People are living at home longer these days, what do you notice about this?

What is the role of noaberschap according to you?

On accessibility for elderly

What kind of mobility possibilities are there for the elderly at the moment?

What could be better in this?

Do you have an overview of what other areas are doing for older people in this area?

What local initiatives do you see and are they getting off the ground easily?

What do you think are the biggest challenges in the city of Groningen and what in the villages/rural areas?

Are there aspects that make the province of Groningen different from other provinces?

What do older people find difficult and what works well?

What are you currently doing to stimulate the elderly to use public transport?

Do you think that public transport is well organized for the elderly everywhere?

What could be improved in terms of information supply to get elderly into public transport?

There are different types of carriers, does this make it complicated for older people?

The future

Do you feel that older people are getting better at using technology?

Does that technology work hindering or stimulating?

How do you support this?

Are there then opportunities for apps?

What trends (e.g., mobility) might make older people more agile in the future? What would you like to see?

To what extent can technology help the elderly in 2030 to live more independently?

On Wmo-indicating process

What is your view on the fact that older people are living at home for longer and longer periods of time?

Can you tell me something about how you indicate and what differences there are between the municipalities in the province?

Should you differentiate more in the budget that goes to transportation per person and the number of kilometres someone gets?

What are your expectations for transportation demand for Wmo-transport in the future?

Is the current way of indicating sustainable in the future?

Other questions

To your knowledge, are there any recent studies on satisfaction among older people?

What would you like to get out of this research? Do you have any questions for me or anything I should investigate?

Who/what would you recommend as an interesting parties to interview?

For the public transport ambassadors

Are there enough volunteers to be found?

For the province of Groningen

In what ways can the province encourage older people to use public transport?

For Liselotte Bingen

The report states that the demand for transport for Wmo transport will increase in the future due to, for example, the

aging population. It is important to make this future target group more familiar with public transport. What, in your opinion, should be done more in this regard?

Do you have an idea whether the elderly of tomorrow will make more or less use of Public Transport as they become more vital and can travel more easily?

Do you expect that a growth in the number of Wmo-indicated will also immediately lead to more costs? Vans can also take more people at a time for example.

In the context of broad prosperity, are the mobility goals now sufficiently focused on encouraging older people to contribute to society?

If I understand correctly, you use population projections to predict the target group for the coming years, but more research was needed into the specification per municipality, I read on the website. Can you tell us a little more about that?

You are going to do a trial with Glimble, how might that help you and the elderly?