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Master Thesis

Shared mobility in rural Drenthe

“How perceived accessibility and attitudes affect car-sharing as a mobility solution”

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August, 2023

Colophon

Title	Shared mobility in Rural Drenthe
Subtitle	How perceived accessibility and attitudes affect car-sharing as a mobility solution
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Second assessor	F.J. Pot
Date	August 3, 2023
Wordcount (excl. summary, table of contents, references and appenix)	18.198

Abstract

Spatial accessibility in rural areas is low because most jobs and facilities are located in and around urban areas. As a result rural land-use and transport systems often fail to serve all rural residents with a sufficient level of accessibility, leading to social exclusion. With the recent public transport cut in the Netherlands, car dependency in rural areas is growing and accessibility for non-car owners declining. But increasing environmental concerns and growing popularity of shared economy have made room to rethink the issue of transport mobility. As a result, shared mobility is gaining interest, also in the Netherlands. However research into shared mobility in rural areas, also in relation to accessibility, is lacking. Therefore this study aims to explore the possible contribution car-sharing can have to the accessibility rural dwellers. The underlying objective is to get insight into the determining factors in citizens' shared mobility adoption intentions.

A multiple quantitative case study was conducted in six remote villages in Drenthe, the Netherlands, to examine rural residents their perceived accessibility, current travel mode and satisfaction and intended car-sharing adoption. Several statistical test including multivariate ordinal regression were used to analyse the collected data (N=204). The results show that accessibility is perceived high, except for walkers and public-transport users. Public transport users as a result are mostly dissatisfied with this mode of transport. High perceived benefits of car-sharing and the positive technological attitude of rural residents were found to increase ones car- sharing adoption intention. To aim for a future sustainable and social inclusive transportation system, guiding policies are needed. For example public actor should emphasize the environmental and social goals of car-sharing. Investments in campaigns and pilot projects could increase the potential user-base. Furthermore investment in multi-modal hubs can play a facilitating role in further developing a shared mobility system. Investments in car accessibility should be kept to a minimum. In fact, walking, cycling and public transport should receive the most attention in order to increase sustainable multi-modal trips. Lastly, car-sharing should be integrated in an efficient and affordable public transport system.

Keywords: Accessibility, Mobility, Perceived accessibility, Shared mobility, Car-sharing, Mobility hub, Rurality

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List of abbreviations

B2B	Business to Business
B2C	Business to Consumer
C2C	Consumer to Consumer
EA	Environmental Attitude
ECS	Electric Car-sharing Services
ITS	Intention To Share
KiM	Kennisinstituut Mobiliteitsbeleid
MaaS	Mobility as a Service
P2P	Peer to Peer
PAC	Perceived Accessibility
PB	Perceived Benefits
TA	Technological Attitude

1. Introduction

1.1. Relevance: Background and problem definition

As a result of increased car ownership in the Netherlands, most jobs and facilities are located around urban areas and alongside highways (Hamers et al., 2014). At the same time public transport is increasingly concentrated at urban corridors linking the major urban hubs. So, individuals without a car or the absence of access to public transport have limited access to jobs and facilities like healthcare, education and social activities. A recent study in the UK shows that the individuals with limited access are mostly either in low income groups, unemployed, disabled, elderly or youth living in the suburbs or in rural areas (Social Exclusion Unit, 2003). For authorities it is difficult to provide a level of public transport service in sub-urban and rural areas that on the one hand satisfies rural dwellers and on the other hand is financially reasonable for taxpayers (Hult et al, 2021). Consequently rural land use and transport systems often fail to serve all rural residents with a sufficient level of accessibility, leading to social exclusion (Silva, 2012).

Additionally, in the past years the Dutch national government had to cut on public transport because of dropping passenger numbers (Het Parool, 2022). One consequence of the public transport cut is the disappearance of bus stops and bus lines. Compared to 5 years ago, in total 1500 bus stops disappeared with the highest percentage of decline in Drenthe, namely 17% (NOS, 2023). Despite the relatively high percentage of car ownership amongst citizens of Drenthe (66.5% according to Vinkenvleugel, 2022), there will be negative effects of the disappearance of bus stops to the accessibility of rural dwellers without the ownership of a motorized vehicle. In other words there is a threat of increased social exclusion in Drenthe.

Accessibility is defined as the ability of an individual to move from one place to another to take part in an activity (Jones, 1981). The ability to move from A to B is dependent on the geographical location (land-use) and the desired sources of supply (transport). Besides, also personal characteristics, time of day and stage in life are relevant factors in defining accessibility (Farrington and Farrington, 2004). Policies designed for improving accessibility often include improving transport mobility opportunities (Ibid.). Transport mobility is defined as 'the ability to move' and therefore is a means to accessibility. Mobility is studied on the basis of travel patterns and transport mode choices (Bastiaanssen & Breedijk, 2022). Existing research argues that there is a need for the integration of land-use and transport policies to enable accessibility (Silva, 2012).

Recent increased environmental concerns and the growing popularity of the shared economy has made room to rethink the issue of mobility. A shared economy enables access to goods and services beyond ownership. Examples are shared housing (AirBnB), shared work spaces (co-working) and shared vehicles (Car2Go). So in response to recent mobility problems such as increased pollution, degradation of the landscape quality and social exclusion, the interest in shared mobility has grown, also in the Netherlands (Silva, 2012). Shared mobility can "provide short access to shared vehicles according to the users' need instead of requiring vehicle ownership" (Machado et al., 2018). The concept of sharing enables a new mentality where the importance of private car ownership is decreasing and people use shared transportation service to their convenience. It includes for example various forms of car-sharing, bike-sharing, ride-sharing or on-demand ride-services. All in all, shared mobility systems have the potential to provide societal, economic and environmental benefits (Mourad, 2019).

In the last decades shared mobility has been widely studied in the field of transportation and sustainability. Researchers have studied the strategical, tactical and operational implications of shared mobility systems (Laporte et al., 2015). Furuhata et al. (2013) for example identified three main challenges for providers of shared rides; designing attractive mechanisms, proper ride arrangement and building trust among unknown passengers. Shared mobility in most studies is seen as a means to decrease congestion, pollution and transportation costs. However, the subject is mainly researched in and around urban settings.

As stressed before, accessibility is dependent on land-use and transport. These variables are location specific and therefore different for urban and rural areas. Rural areas are characterised by low population density because rural settlements are spread out over larger areas (Dasgupta et al., 2014). Therefore, infrastructure is limited, for instance rural areas have a less advanced road network and a limited amount of public transport services. According to Phillips and Williams (1984) accessibility is 'the key identifier of the rural experience in cases of bus deregulation' because then the level of experienced accessibility between rural households with and without cars increases. Nonetheless, urban and rural areas are very much interdependent. For example urban areas rely on rural areas with regards to the demand for food, water and raw materials, whereas rural areas benefit from urban developments in the form of market and employment opportunities (Gebre & Gebremedhin, 2019).

A general trend in rural residences is the outflow of young adults because of low social and economic living standards (Li et al., 2019). The outmigration of young rural people in the Netherlands is often determined by higher education and the perceived employment opportunities (Thissen et al., 2010). As a result of this 'brain drain', the average age grows, and elderly become the main part of the rural population. Moreover, the economic development in rural areas is threatened. However, low-density regions according to Porru et al. (2019) are fairly different from each other, 'both depending on the different needs of their dwellers and other pre-existing conditions related to their specific context'. In relation to public transport and shared mobility in rural regions, De Jong et al. (2011) identify three key factors for success; the availability of financial means, cooperation between stakeholders, and a flexible supply of scheduled and on-demand transports.

Rural residents often live a more traditional lifestyle. In addition they believe that nature should be preserved as a resource for consumption, whereas city residents more often argue that nature should be preserved for its own sake (Clayton, 2012). Yet, measured environmental concern is often not different between urban and rural residences (Ibid.). However, it is argued that there is higher resistance to the submission to behavioural, lifestyle, livelihood and socio-cultural changes compared to urban areas (Adjei et al., 2016). For example regarding technological innovations. In comparison to cities and urban contexts, recent technological innovations and the awareness of them arrive at a later stage in rural areas. Rural inhabitants as a consequence need more time to get acquainted with technologies (Porru et al., 2019).

Because of the existing dissimilar geographical, demographic, social and economic characteristics between urban and rural regions it is interesting to study shared mobility opportunities within the rural context. Also because, as explained, rural areas are aging, but shared mobility programs can face difficulties for elderly because of technological barriers. In particular this research tries to shed light on the accessibility problem that is often existing in this context. Currently there is limited knowledge regarding the adoption intention and choice of car-sharing service of individual users (Prieto et al., 2017). By exploring rural dwellers their perceived accessibility and by analysing their shared mobility adoption intention, this study allows for identification of mobility needs. Especially what role shared modes of transport can play in accessibility of rural dwellers and under what circumstances a shared mobility system can be adopted.

1.2. Research aim and questions

This thesis aims to explore shared mobility options, in particular car-sharing, in rural areas which could possibly contribute to the accessibility of rural dwellers. The underlying objective is to get insight into the determining factors in citizens' shared mobility adoption intentions. For this research the focus area is the province of Drenthe in the Netherlands. Currently the availability of shared modes of transport in Drenthe, especially in rural areas, is very limited. However recently, from September 2022, Drenthe together with region Groningen-Assen and car company Century are testing a pilot project with 13 electric shared cars through Groningen and Drenthe at different hubs and village centres (Provincie Drenthe, 2022). The project's goal is to work towards a sustainable and accessible rural region and to experience how shared cars can contribute to this. The province of Drenthe is expecting shared mobility to be a promising solution to the increasing distances to facilities and car dependence in rural areas (Gedeputeerde staten van Drenthe, 2020). In line with this pilot, and because in rural areas travel distances are longer, the focus of this research is on shared cars (Kennisinstituut voor Mobiliteitsbeleid, 2019). Moreover, to align with the discussed problem of accessibility and social exclusion, it is also aimed to shed light on the role of shared cars for non-car owners.

Subsequently to the research aim, the main research question that is tried to answer within this research is:

"How do perceived accessibility and attitudes towards sharing affect car-sharing as a mobility solution for rural areas in Drenthe?"

In order to answer the main question the following sub-questions will be explored:

1. *What is the current availability of car-sharing services in the Netherlands and Drenthe?*
2. *How do citizens in rural areas in Drenthe experience their current mode of transport?*
3. *What are the determinants for sharing adoption intentions among citizens in rural areas in Drenthe?*
4. *What are the differences in perceived accessibility and sharing adoption intention between different village sizes in Drenthe?*

1.3. Reading guide

This thesis is organized into 7 chapters. After the first, introduction chapter, a literature review will follow in which the relevant theories around accessibility and shared mobility are discussed. The concepts explaining the relationship between accessibility and shared mobility are set out in a conceptual model. Chapter 3 explains the methods employed in this research. Besides an explanation of how data is collected, it will also explain how data is analysed and how it contributes to answering the research questions. In chapter 4 the results of the collected data will be presented and analysed with the help of various tools. Chapter 5 follows which discusses the results with existing research in hindsight. Then the concluding chapter 6, provides answers to the main research question as well as the sub-questions. Based on these answers, policy recommendations are proposed. Lastly, chapter 7 will reflect upon the research with regards to its strengths, weaknesses and limitations. It will also provide direction for future research relating to the topic of shared mobility in rural areas.

2. Theoretical framework

2.1. Accessibility

Accessibility expresses the multiple interactions between the spatial characteristics of a place, their socio-economic structure, and the mobility of their inhabitants (Brovarone et al., 2020). According to Geurs and van Wee (2004) accessibility can be defined as "the extent to which land-use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport mode(s)". Silva (2013) illustrates the earliest found interaction between land-use and transport, the land-use and transport (LUT) feedback cycle by Wegner and Fürst (1999) (figure 1). The LUT cycle explains that locations that are highly accessible are attractive and have high market value. As a result economic activities take place at the good accessible locations and transport systems emerge to serve the urban developments. Therefore it is argued that in order to shape mobility patterns, land-use and transport policies need integration (Silva, 2013).

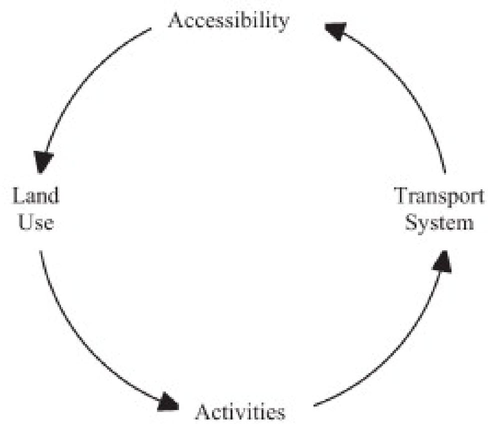

Figure 1: Land-use and transport (LUT) feedback cycle (Wegner & Fürst, 1999).

However, land-use and transport is different in urban settings compared to rural settings. It is widely agreed upon that in rural areas it is a challenge to guarantee adequate levels of accessibility due to rural settlement features, socio-economic and cultural processes (Brovarone et al., 2020., Mosely, 1979). Examples of such rural characteristics are dwellings that are distributed over large areas, low population density and therefore potential passenger numbers are limited and the level of transport demand is unpredictable (Velega, 2012). As a result, public transport systems in rural areas have limited service coverage. So in low rural densities with long distances and absence of local facilities there is a domination of private road vehicles (Nutley, 2003). But considering car dependency, the group of 'young, poor, handicapped and old' is disadvantaged. Because for these groups it is either difficult or impossible to drive or own a car or another motorized vehicle. These socio-economic and demographic variables are known as the 'individual component' and are of influence to a persons' accessibility (Van Wee, 2022). Besides, people have their own needs, attitudes and preferences for activities and modes of transport (Kitamura et al., 1997). In the last decades living in rural areas has become a matter of personal choice (Bullock et al, 2011). Individuals wanting to live in the countryside make a trade-off between the attractions of the rural environment and practical choices about for example distance to labour, shops and public transport (Ibid.). Another concept that is relevant for accessibility is a person's substitutability. According to Van Wee et al. (2019) substitutability is the "flexibility and the ability to deal with options to substitute parts of a trip or a whole trip or activity pattern". For example when someone can easily change their residential location, or destination (for example a school) but does not do it, a low level of accessibility is not problematic to them (Ibid). Geurs et al. (2019) relate the concept of ‘option values’ to flexibility. It is argued that people add value to having multiple travel options available, even if they don’t use them (yet). Also an individuals’ social network matters to their degree of accessibility. Research by Dugundji et al. (2011) shows that travel needs and patterns are related to the social context. For example social relations can be a reason for a person not to change their residential location.

2.1.1 Social exclusion and perceived accessibility

Over the last decade increased attention has been paid to accessibility and equity (Van Wee, 2022). Accessibility is important to subjective well-being. Thus, not having full access to different travel modes may exclude people from certain activities and negatively affect subjective well-being (Lättman et al., 2016). It is argued that an individual has a ‘too low’ level of accessibility when social exclusion or an undesirable situation is experienced. Social exclusion in the face of accessibility planning can be defined 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 is found that limited car access stimulates social exclusion (Hine & Mitchell, 2016). Therefore, to battle social exclusion, the importance of public transport is emphasized (Stanley & Lucas, 2008). Accessibility however is a normative concept, there is not just one account of what level of accessibility people need. One can evaluate absolute levels of accessibility based on calculated spatial data. But accessibility can be experienced in various ways, dependending on density of population, patterns of settlement and service provision, and income level, among other things. On a larger scale experienced accessibility varies between different societies with different values (Farringon and Farrington, 2005).

In relation to experienced accessibility Pot et al. (2021) explain that the relationship between land-use and transport systems and the potential individual behaviour is mediated by how the environment is perceived. It is argued that by individual processing of the actual environment, the cognitive environment (or perceived environment) is the basis for decisions related to spatial behaviour. Besides individual characteristics perceptions of land-use; the distribution of and distance to activities, transport; supply and resistance (for example, comfort, costs and safety) and the temporal component; variability in travel time and temporal constraints of activity, influence one’s perceived accessibility (Pot et al., 2021). A study into the spatial distribution of perceived accessibility in the Netherlands reveals that in rural areas with lower calculated spatial accessibility perceived accessibility is not that low (Pot et al., 2023). This pattern can be explained by peoples ‘self-selection’, meaning that residential locations are selected based on their needs, desires and abilities concerning accessibility (Ibid.). Residential self-selection has been found to obscure the potential causal relationship between the built-environment and travel behaviour (Cao et al., 2019). According to Lättman et al. (2016) perceived accessibility can be increased by improving the quality of the chosen mode of transport. This implies for example trip planning, comfort or safety. Another important predictor of perceived accessibility is age and the frequency of travel (Ibid.)

2.1.2. Dutch and rural accessibility

Research into mobility and accessibility in the Netherlands reveals that inhabitants of urban areas make more use of public transport, bicycles and walking compared to residents of rural areas (Kennisinstituut voor Mobiliteitsbeleid, 2023). The car as transportation mode is more often used by rural inhabitants than by urban inhabitants. Moreover rural dwellers travel bigger distances for commuting and social activities (Ibid). An interesting fact is that in rural areas only 2% of the trips are multimodal with the most common combination being the bicycle and the train.

Accessibility in the Netherlands is measured in the year 2018 by the 'Kennisinstituut voor Mobiliteitsbeleid' (knowledge institute for mobility policy KiM). Spatial accessibility in this case is defined as "the amount of destinations (jobs, shops and educational institutions) that can be reached from a specific location within a certain travel time using a certain mode of transportation (car, bicycle and public transport). The rural areas of the Netherlands are split up into 2 types: rural area with population growth and rural area with population decline. In figure 2 and 3 the rural accessibility to jobs is mapped, figure 4 and 5 show the rural accessibility to shops and the rural accessibility to education is shown in figure 6 and 7.

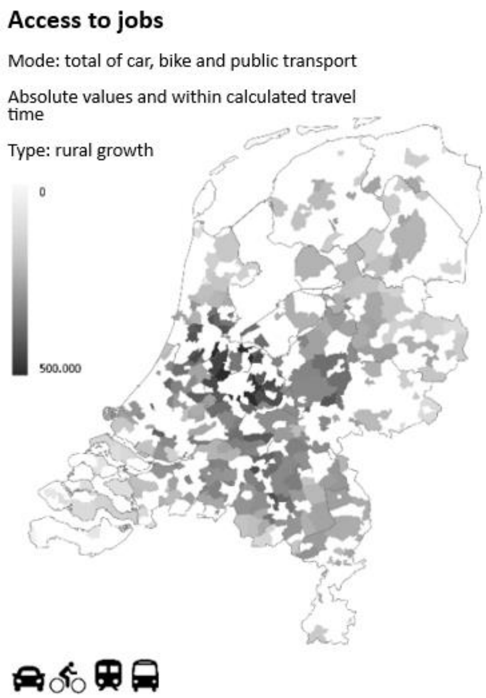

Figure 2: Access to jobs in rural growth (KiM, 2023).

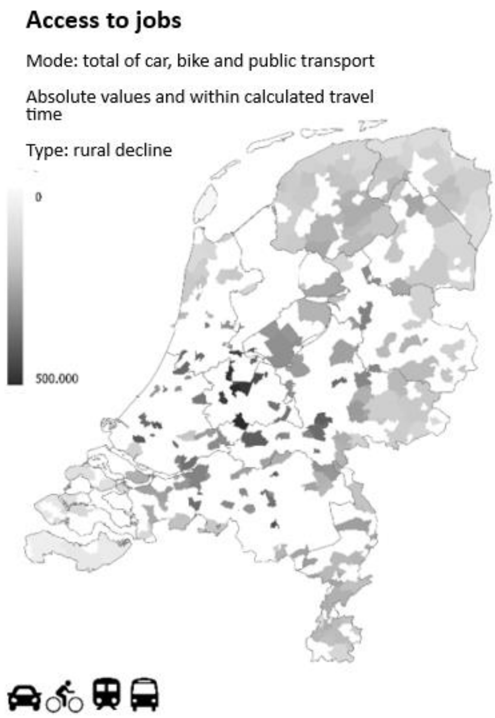

Figure 3: Access to jobs in rural decline regions (KiM, 2023).

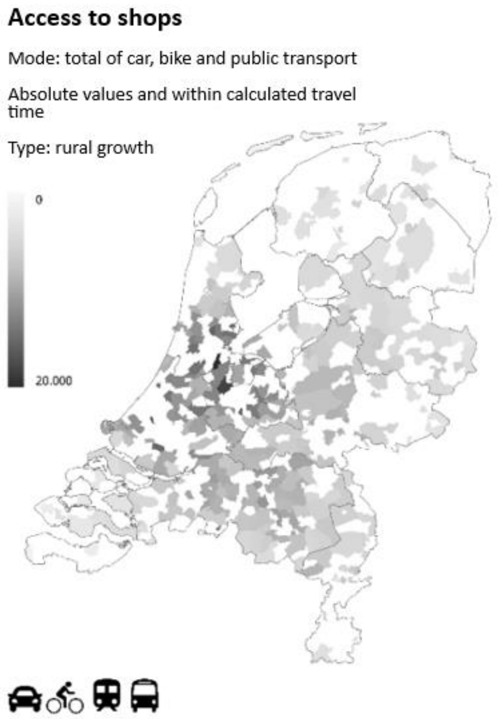

Figure 4: Access to shops in rural growth regions (KiM, 2023).

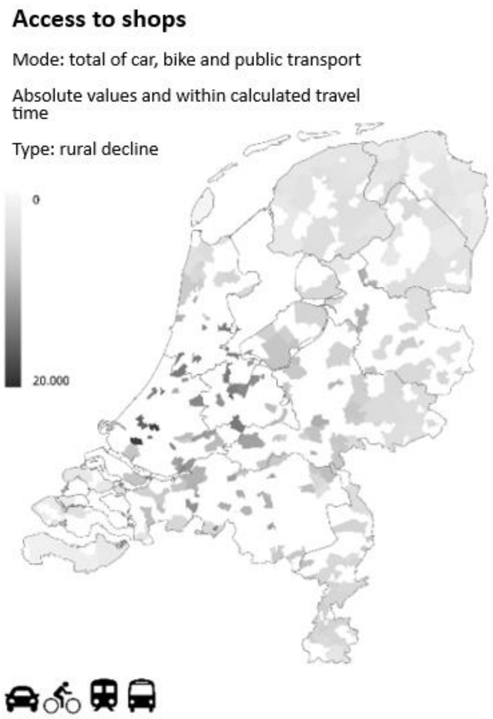

Figure 5: Access to shops in rural decline regions (KiM, 2023).

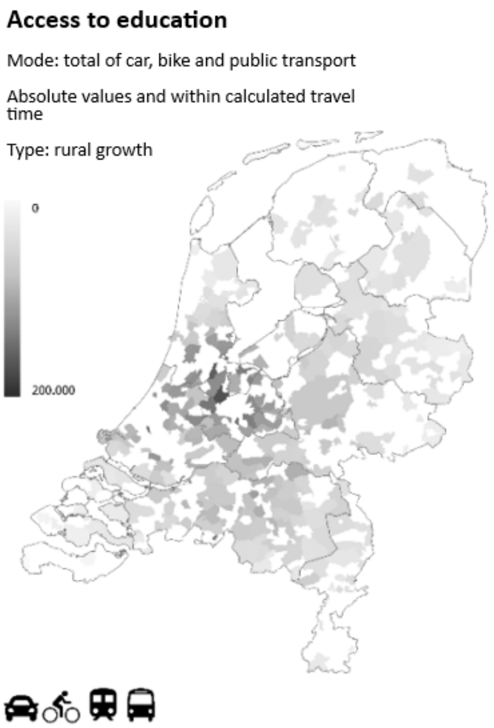

Figure 6: Access to jobs in rural growth regions (KiM, 2023).

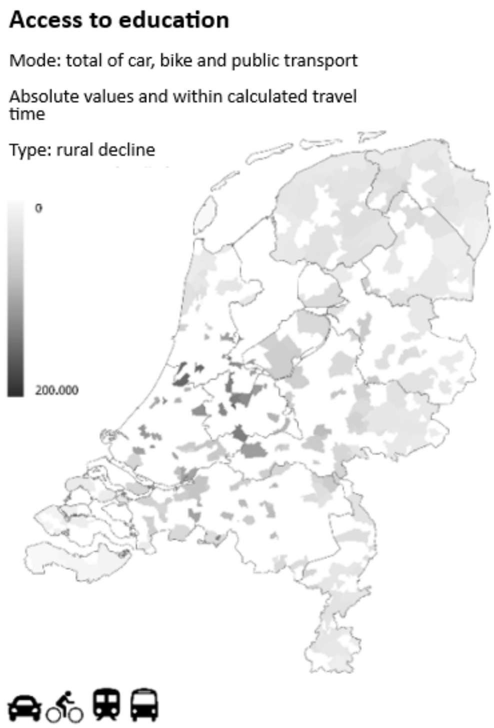

Figure 7: Access to jobs in rural decline regions (KiM, 2023).

The maps show that accessibility to jobs, shops and education is relatively higher around the western cities (in Dutch 'Randstad'). For the province of Drenthe the accessibility to jobs is the highest, followed by shops and at last education. Only for the accessibility to jobs there is a difference within

Drenthe between rural areas in growth and rural areas in decline. Namely in the growing areas the accessibility of jobs is higher. Based on different scenarios it is expected that between 2018 and 2040 there will be decreasing accessibility to jobs, shops and education in declining rural areas. (KiM, 2023).

With regards to perceived accessibility in the Netherlands it is found that low spatial accessibility does not fully translate into low levels of perceived accessibility (Pot et al, 2023). This can be explained by the hypothesis that people self-select into different contexts regarding spatial accessibility based on individual needs, desires and abilities concerning accessibility. In detail it seems that individuals residing in rural locations have less demanding expectations concerning local accessibility compared to those living in urban environments and they are able to manage with fewer nearby opportunities by relying more on car usage (Ibid).

2.1.3 Improving rural accessibility

Improving mobility opportunities is often seen as a means to improve rural accessibility. However Farrington and Farrington (2005) state that improving transport "is likely to be a 'fire-fighting' solution or an afterthought if policy in other sectors is not brought into an integrated system with accessibility as at least one of its main foci, if not the main focus". Besides integration, transport policies should take into account potential changes in travel needs and patterns (Dugundji et al., 2011). As argued by Acheampong & Siiba (2019) exploring public acceptance and intended use of transport modes is a crucial factor to successful systems implementation. People's attitudes and demographic factors play an important role in users' acceptance. In the Netherlands the current solutions with regards to mobility issues are mainly focused on problems or bottlenecks which are not experienced as such by its users (KiM, 2023). So when searching for solutions related to mobility and accessibility, attention should be paid to the perception of residents. Moreover for future transport policy, it is of relevance to take into account individuals' adoption intention of certain transport modes. It is likely that future trips will be strongly influenced by the social context demanding for alternative modes of transport that will rely on broader social support (Ibid). In order to modify travel behaviour it is argued that measures like carpooling, ride sharing – and information provision – including social media can be implemented (Ibid). Relating to the previously discussed concept of flexibility and option values, research into improving rural accessibility reveals that Flexible Transport Systems contribute to the public transport offer (Velaga et al., 2012). Flexible, or on-demand, transport systems include for example shared taxicabs, shuttle vans, dial-a-ride services, ring-and-ride services and dial-up buses. An important factor in the success of flexible transport systems is the implementation of multimodal mobility hubs. Multimodal mobility hubs enable faster connections to other modes of transport and therefore improve accessibility to both workplaces and locations of interest (Frank et al., 2021). Experienced limitations of existing flexible transport systems are that only a specific population category is targeted, booking on day of travel is not allowed, and there is no use of intelligent transport systems and advanced information and communication technology support (Velaga, 2021). Removing these limitations could therefore improve accessibility and thereby social inclusion.

2.2. Shared mobility

In recent years the topic of shared mobility has been widely studied in academic literature. However, there is a lack of a broadly accepted definition of the term leaving the potential for individual interpretation (Castellanos et al., 2020). Prior to shared mobility, terms such as Intelligent Transport Systems (ITS) have been used by practioners and academics. Studies on ITS emphasize the relationship of (digital) technology and transport, tracing back to the late 1960's where research was conducted on how ICT could play a role in the transport sector, mostly in the field of highway management (U.S. Department of Transportation, 2021). In the world of today digital technology in the field of transport and mobility is indispensable. For example the use of GPS, mobile apps to view bus departure times and even self-driving vehicles and autonomous cars are more often appearing in the streetscape. These advanced technologies appear in contemporary terms such as 'smart mobility', 'new mobility' and 'Mobility as a Service' (Paiva et al., 2021). All of these terms subsequently include 'shared mobility' as one of its elements.

Shared mobility as defined by Shaheen (2016) is: "the shared use of a vehicle, bicycle, or other low-speed mode that enables users to have short-term access to transportation modes on an "as-needed" basis". Santos (2018) adds that the shared mobility services are enabled by technology. He proposes four main models; peer-to-peer car rental, modern car club, Uber-like service and new public transport on demand. Whereas Santos' (2018) focus is on big motorized vehicles, Machado et al. (2018) also includes bike-sharing as a model for shared mobility. All in all, in existing literature all authors with an explicit definition of the term acknowledge the importance of technology (mobile phones and the internet) as enablers for shared mobility. In the reviewing paper of Castellanos et al. (2020) it is underpinned that besides vehicles, also other types of mobility assets and services can be shared.

Now that a general definition of the concept is examined, the following paragraphs will discuss different elements of shared mobility and related concepts which are relevant for this research.

2.2.1. Its modalities

The sharing of mobility services for people transportation has the benefit of reducing the number of used vehicles and thus traffic congestion and pollution (Mourad et al., 2019). Moreover, shared mobility has the potential to increase mobility for those without access to private vehicles. The benefits for users of shared mobility is dependent on the type and mode of transport. According to Machado et al. (2018) shared mobility can be organized through the following five categories (figure 8). Since this study focusses on automated vehicles, 'Carsharing', 'Personal Vehicle Sharing', 'Ridesharing' and 'On Demand Ride Services' will be discussed.

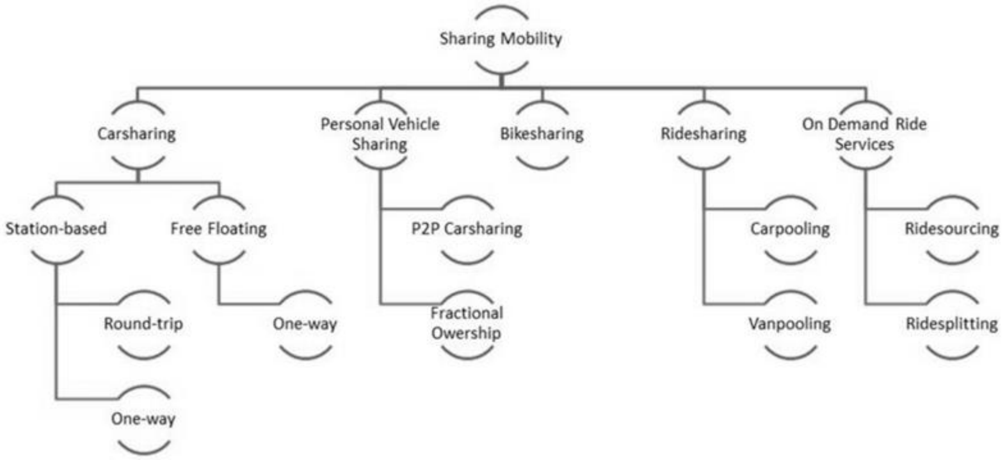

Figure 8: Shared modes of transport (Machado et al., 2018).

With car-sharing, or vehicle sharing, commuters register with a company and book to use a car when they are in need of one (Acheampong & Siiba, 2019). Botsman and Rogers (2010) explain it as a consumption model that enables users to pay for the benefits without themselves bearing the costs and responsibilities associated with ownership. Car-sharing can be implemented as either 'station-based' or 'free floating' systems. Station based systems offer round-trips or one-way trips where consumers reserve a car and pick it up at a designated location (Acheampong & Siiba, 2019). This type of pre-arranged shared commuting where travellers' demand is known is mostly used for regular commuter trips as well as shared long-distance trips (Mourad, 2019). In a free floating system customers check the availability and location of the vehicle online, they use it, and return within the designated service area (Machado et al., 2018). Because of the flexibility of this system it is appealing to both public transit users as well as private car users (Becker et al., 2017). But according to Sprei et al. (2019) the service is mainly used for shorter trips.

In a system of 'Personal Vehicle Sharing' car owners rent their car to other drivers on a short term basis (Machado et al., 2018). Personal vehicle sharing can be deployed either as 'Peer to Peer' (P2P) or fractional ownership. With P2P car-sharing privately owned vehicles are temporarily made available for 'would be renters' who are members of a car-sharing company (operator). The operator is responsible for the rental procedures, scheduling and requests for access (Machado et al., 2018). Benefits of this system are that there is a great selection of locations, vehicle types and rental prices available. Moreover, it promotes the sharing of already owned cars. In the 'Fractional Ownership' model a vehicle is owned by a group of individuals who all take up a portion of the costs for accessing the vehicle. The sharing can be done through a partnership with a car-sharing company that rents out the vehicle. This system is not very flexible because when a member wants to hand in their ownership, other members need to take over the costs and on the other hand finding new members is difficult because of the locality of the shared vehicle.

Ridesharing can transport multiple travellers with overlapping trip origins or destinations and travel times in the same car ('Carpooling') or van ('Vanpooling') (Chen et al., 2017). Empirical evidence indicates that ridesharing has environmental benefits and participants benefit from shared travel costs, social interaction and stress reduction (Shaheen et al., 2017). 'Carpooling' and 'Vanpooling' (7 to 15 people) often occurs in informal settings based on community initiatives. But there are digital application initiatives aiming to centralize the pooling market by enabling contact between people and allowing drivers to be compensated for the ride(Machado et al., 2018).

Lastly, ‘On Demand Ride Services’ are door-to-door transportation services which can be accessed by virtual platforms (Machado et al., 2018). One segment of On Demand Ride services is ‘Ridesourcing’ which uses private vehicles for paid on-demand rides. An example of such an operating company is Uber. This method of sharing saves the traveller costs of buying and maintaining a car and it allows to spend travel time on other activities (Alemi et al., 2017 & Speranza, 2018). Another advantage compared to a regular taxi is that cars can be reserved indoors and that there is trust between drivers and users because both are registered within the reservation system and thus personal information is known.

In the Dutch context, according to Jorritsma et al. (2021), the amount of available shared cars in 2020 compared to the previous year has grown with 26% to 64.000. The majority of car-sharing supply - 88% - comes from Personal Vehicle Sharing (or Consumer-to-Consumer systems (C2C)). This type of system is particularly popular through Peer-to-Peer (P2P) platforms like Snappcar. Additionally, local communities sometimes share one or more cars. This type of supply has grown with 34% from 2019 to 2020. Meanwhile, Business-to-Consumer (B2C) car-sharing supply - station-based and free-floating systems - make up a smaller share of the market with 10% of the total supply in 2020. Lastly 7% of shared cars is Business-to-Business (B2B) where the supply is focussed on operating for business purposes. ‘Ridesharing’ and ‘On Demand Ride Services’ are currently not, to scarcely, occurring in the Netherlands.

2.2.2. Its impacts

According to Cohen & Shaheen (2018) shared mobility influences urban planning in the facets of transportation and circulation, zoning, land-use and growth-management, urban design, housing, economic development, environmental policy, conservation and climate action. Understanding the impacts of shared modes of transport is relevant for policy makers to make use of the positive effects and limit the negative effects in order to achieve public policy goals.

For transportation and circulation it is argued that shared mobility influences travel patterns, such as modal choice, vehicle occupancy, and vehicle miles travelled. Studies have examined that the use of a private car is more difficult to be substituted when trip distance increases (Li & Kamargianni, 2019). As a matter of fact, for shorter trips the demand for private cars need to be suppressed and the demand for car-sharing should be promoted; “otherwise the increasing demand for car-sharing would mainly come from bus users” (Ibid.). Furthermore it is argued that shared modes can bridge the existing gaps in transportation networks because it can extend the catchment area of public transport and encourage multi-modality (Shaheen & Cohen, 2018). It is also found that shared modes can address the first-and-last mile issue related to the access of public transit (Ibid.)

With regards to zoning, land-use and growth management, shared mobility can impact land use related planning factors (Cohen & Shaheen, 2018). Roukouni & Correira (2020) specify three main themes that have been the subject of research so far; impacts on parking supply, land use, and urban aesthetics. It is found that with increasing shared mobility there is a reduction in parking needs which allows the public space to be used for other purposes (ITF, 2017). This can be explained by the fact that a decrease in private car use results in lower total number of used cars and thus in a reduction of needed parking spots. Additionally shared mobility can potentially support affordable housing strategies by for example reduced parking demand and allowance for lower minimum parking requirements at new housing developments (Cohen & Shaheen, 2018).

In relation to the previously discussed facet of transportation, urban design is impacted through for example the support of sustainability principles by promoting walking and cycling. In addition to the first-and-last-mile issue, connections to public transportation are provided, potentially reducing the need for privately owned cars (Cohen & Shaheen, 2018).

Economically, studies have found that the use of shared mobility can result in financial benefits for individuals and households by vehicle and ride sharing, thereby reducing costs. Moreover, it can diminish the necessity for personal vehicle ownership, leading to additional cost savings. Consequently, citizens can allocate a larger amount of money towards purchasing other goods and services. This way, the presence of shared mobility hubs can also influence the overall economic vitality of the surrounding region (Roukouni & Correira, 2020). Another way in which shared mobility could impact the economy is by the level of employment because of recruitment of drivers (Roukouni & Correreira, 2020). However this is especially the case for on demand sharing services. In the case of B2C or B2B systems, levels of employment can be impacted through the establishment of sharing companies. Lastly, a study into the effects of bike-sharing on the economy found that sharing programs can help users save time, which further promotes the economic development of the place because this time can be spent on other activities (Qiu & He, 2018).

In terms of the environmental impact of shared mobility, it is found that car-sharing reduces the vehicle miles travelled and therefore lowers the greenhouse gas emissions (Cohen & Shaheen, 2018). Based on a survey amongst car-sharing individuals in the Netherlands, Nijland & Meerkerk (2017) conclude that car-sharing has led to a decrease of over 30% in car ownership among car sharers. This is especially true for individuals who were already engaged in car-sharing. Many of them reported that they got rid of their privately owned vehicle after they began car-sharing. The shared car predominantly replaced a second or third car that they previously owned. Moreover, the vehicle miles travelled amongst car-sharing individuals decreased with 15%-20% due to the fact that after disposing a car, people tend to drive considerably less. Finally the findings reveal that car-sharing resulted in an average reduction in CO_2 emissions ranging from 236 to 392 kg per participant. This is equal to a reduction of approximately 13% to 18% in emissions related to car ownership and car usage. However Briceno et al. (2005) argue about the potential rebound effect of people saving on transport expenditure, possibly spending that money on other forms of consumption with alternative additional emissions.

Another relevant impact of shared mobility is on society, for example transportation equity (Roukouni & Correira, 2020). It is argued that access to jobs and other services is more equitable after the introduction of shared mobility due to improvements in access (International Transport Forum, 2017). But the main question with regards to transportation equity is: who are enjoying this new transportation option and who are excluded from it? It is acknowledged that younger people are more interested in shared modes of transportation (Jin et al., 2018). This could be linked to the digital divide, which refers to the required digital skills and the unequal access to smartphone and mobile data (Ibid.). Namely because most car-sharing services make use of smartphone based apps (Dias et al., 2017). Section 2.2.3 will explore this theme further.

The impact of car-sharing on people is difficult to measure because data should contain information about the direct modal shift that people made. Still, surveying respondents about the impact that sharing vehicles has on their lives can be reported. It is found that many individuals tend to drive more once they begin car-sharing (Cohen & Shaheen, 2018). In addition they have easier access to vehicles. On the other hand some individuals will significantly reduce their driving as using a car becomes a necessity instead of convenience. The influence of car-sharing on people's lives varies: for some, it has a minimal impact, while for others, it plays a vital role in enabling lifestyle changes such as enhanced mobility, decreased fuel consumption, and reduced emissions.

However, despite the evidence in existing literature that shared mobility has the potential to provide several benefits and positive effects to cities, it is also clear from the research performed that shared mobility must not be treated as a panacea to all the urban challenges (Roukouni & Correia, 2020). It is namely found in some studies that introducing forms of shared modes and services has resulted in negative effects like traffic jams and additional motorized vehicle travelled kilometres causing additional emissions (Erhardt et al., 2019). Moreover, in some cases the development of new shared mobility systems are not proven successful and operation ended shortly after their introduction (Sun et al., 2018). All in all, it is important to consider the potential rebound effects.

2.2.3. Its users and intended users

Most of the sharing services have been developed in high-density areas (Prieto et al., 2017). Because in the high-density metropolitan areas C2B sharing services are most profitable. The revenues namely are directly derived from user behaviour meaning that sharing companies are in need of subscribers willing to frequently use the service (Ibid.). In reality, many existing car-sharing programs are financially supported by communities and governments through measures such as tax incentives, starting investments, free parking spaces, and marketing campaigns. Meanwhile, alternative strategies for enhancing the profitability of car-sharing services involve attracting a greater number of members through subscription fees but reducing the frequency of usage (De Luca & Di Pace, 2015).

Socio-demographic factors are known to affect mobility patterns and travel modes. Moreover it has been argued that demographic factors are the main determinants for travel demand and therefore relevant to know in order to increase the supply of shared mobility (Metz, 2012). In general there is no clear user profile for shared transportation. Specifically the attracted groups are dependent on the mode of the shared transportation. Users of shared mobility include public transport users without the financial means to buy, maintain or operate a private vehicle. Machado et al. (2018) argue that this group sporadically uses a shared system to "reduce transportation costs and improve travel efficiency". Moreover, shared users include a group of users who are unable or unwilling to drive a car. For example elderly who are attracted by on-demand ride services. With regards to users of car-sharing systems, a study conducted in Singapore found that the majority of users are middle-income, married men with an age between 30 and 39 years and living in a 4.2 person household (Seik, 2000). In the USA the car-sharing user profile is found to be middle-incomers with an average age of 37 years (Zhou, 2012). A European study in Milan on the users of sharing company Car2Go revealed that most frequent users are under the age of 35, employed, male, higher educated residents in the city (Arcidiacono & Pais, 2018). This group is mostly attracted by the flexibility and convenience of sharing. Overall many studies acknowledge that shared modes of transport are more likely to be used by younger, better-educated, and more wealthy individuals (Jin et al., 2018). Wappelhorst et al. (2014) have studied the potential of electric car-sharing in urban and rural areas in Germany and conclude that rural residents appear to be as open to car-sharing as individuals living in urban contexts.

From a socio-psychological viewpoint, car-sharing adoption intention is influenced by one's attitudes since this is one of the key determinants of behavioural intentions (Acheampong & Siiba, 2019). Attitudes reflect the expectations of the outcomes of a behavioural choice and the importance one attaches to those outcomes (Ajzen, 1991). According to Ajzens' Theory of Planned Behaviour, and in relation to car-sharing, a person's attitude reflects their assessment of the potential benefits and drawbacks of car-sharing. As a result, factors such as flexibility, convenience, and affordability in relation to travel options have been identified as influential factors affecting the intention to adopt car-sharing (Becker et al., 2017). Two other common attributes shared by potential users appear to be environmental concerns and familiarity with technology (Machado et al., 2018). Considering that car- sharing is seen as an environmentally sustainable alternative to car ownership and technology has played a key role in shared-mobility, perceptions and attitudes towards the environment and technology most likely influence users' adoption intention (Acheampong & Siiba, 2019). The main motives for users to adopt a car-sharing system according to Schaefers (2013) based on a qualitative means-end chain analysis are:

> Value seeking: Sharing mobility is seen as financial beneficial for users because of reasonable prices and free parking. Moreover, the economic burden is easy to calculate and the spending on owning a car can decrease. The additional savings by using car-sharing can be spent on other things, contributing to the core value of quality of life.
>
> Convenience: The desire of car-sharing users to make their life easier in terms of parking, flexible usage and reduced responsibility. Enabling customers to save time by using a sharing service is important to the quality of life. Moreover, high levels of availability and reliability represent the underlying motive for reducing time and effort.
>
> Lifestyle: Connecting to the social context, car-sharing associates a sense of belonging and community among other car-sharers. Besides the inherent pleasure of driving shared car-sharing customers are recognizable which is desired by status and the ability to interact with others and talk about sharing.
>
> Sustainability: As car-sharing is regarded as a sustainable mode of transport, environmental awareness is seen as an important psychological consequence for car sharers because of size, fuel efficiency and the ability to live without a private car. It is found that vehicle sharing customers are willing to pay more for environmentally-friendly alternatives. However, sustainability is not a predominant motive but a positive side-effect.

All in all car-sharing users appear to have more motives that directly relate to personal benefits, for example costs or time savings, than motives that only have an indirect influence on them, like helping the environment (Schaefers, 2013).

It is argued by Acheampong & Siiba (2019) that modal choice and individuals' satisfaction with their current mode of transport reflect the possible gap between "individuals' expectations regarding their daily travel expectations on the one hand and their experiences on the other hand". As a result, the experience-expectation gap could serve as a valuable benchmark for individuals to assess the perceived benefits of car-sharing. Moreover, as also stated by Prieto et al. (2017), car-sharing could serve specific transportation needs to those who are not satisfied with a private car or public transport. It is therefore argued that current travel mode and satisfaction directly predict ones intention to car-share (Acheampong & Siiba, 2019).

To meet the desires of potential users it is argued that "shared vehicles should reflect environmental and social awareness, which explains why electric and hybrid vehicles are gaining momentum in shared mobility systems" (Machado et al., 2018). Electric vehicles contribute to sustainable, climate and environmentally friendly mobility, however electric operated cars have not spread to their full potential (Wappelhorst et al. ,2014). Mainly because buying an electric car is more costly than a non-electric car and it has a limited driving range. In rural areas, new mobility services struggle to grow because of car affinity and dependency (Ibid.). To change the current situation, two approaches can be implemented: the incorporation of electric vehicles into shared mobility networks and the integration of these networks with both urban and interurban public transportation systems. The integration in both systems is of importance because despite the fact that rural residents appear to be open towards electric car-sharing, this group alone cannot ensure the complete economic viability of the system.

2.2.4. A HUB system

Improved public transportation, encouraging active modes (for example walking and cycling), and the introduction of shared mobility provide a solution to the need for sustainable mobility. Nonetheless, these solutions involve a major reliance on multimodality which results in less attractive transfers for travellers (Blad et al., 2022). Multimodal trips comprise of two or more legs with intermediate transfers (Rongen et al., 2022). To tackle this problem the concept of (shared) mobility hub is proposed. The hub serves as a central location where all transportation modes (public transport, walking, cycling, private vehicles and shared mobility) converge, offering a more convenient transfer point. A shared mobility hub can be defined as “a location where multiple sustainable transport modes come together at one place, providing a seamless connection between modes, offering besides public transport several shared mobility options, but also potentially including other amenities, ranging from retail, workplaces, to parcel pick-up points like lockers” (Blad et al., 2022). Blad et al. (2022) identify three types of shared mobility hubs based on their function in the transport system and the urban context. A residential shared mobility hub provides shared transportation options exclusively for local residents, and it is not directly integrated with the public transport system. On the other hand, a city and regional shared mobility hub offer public transportation services and focus on multiple target groups. The main difference between the city and regional shared mobility hubs is their location: the city hub is situated in densely populated city centres, while the regional hub is found in less crowded areas, either within or outside the city. Bell (2019) considers one more category in the hub typology namely the basic hub, which provides the main getaway to public transport mainly in rural villages, mainly accessed by walking or cycling. It serves as a primary access point for individuals without a privately owned car.

In the rural context, policy makers consider multimodal mobility hubs to be beneficial in improving accessibility (Frank et al., 2021). Because new mobility services, like shared mobility, can link to the existing (public) transport system and hence enable new and faster intermodal trip transfers (Ibid.). In detail, it is argued that in areas with low public transport supply, shared modes of transport potentially complement public transport by offering important first-and last-mile connections (Kask et al., 2021). However, the development of mobility hubs in areas with low demand can be challenging (Rongen et al., 2022). Coenegrachts et al. (2021) found that implementation of shared mobility hubs can have adverse effects as a result of substitution of publicly-funded transport services. Moreover, with an increasing area density, positive financial return becomes more likely. Therefore it is argued that collaboration between public and private companies is crucial in effectively organizing service supplies at a hub location and providing an integrated travel product (Rongen et al., 2022). Hubs often are located on public ground which causes different levels of government taking different roles in hub developments (Kask et al., 2021). The national or regional government can play a vital role in promoting the development of hubs on a local or regional level. They can assist in various ways, including facilitating coordination among different stakeholders and sharing knowledge about innovative mobility concepts and efficient use of space and resources (Witte et al., 2021).

Furthermore, the government can take on a financing role, particularly in creating a cohesive hub network with standardized branding and communication at the national or regional level. Additionally, the national government can play part in establishing pre-conditions that are best handled at a national level, such as data standards for sharing, using user data and allowances for the use of shared mobility (Witte et al., 2021). In order to assist the implementation of new mobility services, such as shared mobility hubs, Storme et al. (2021) propose the following recommendations:

> Private actors play an important role in implementing new mobility services. Public and private transport is essential to establish new mobility systems as practical alternatives to private cars.
>
> Funding is vital for the successful implementation of new mobility services, and it can be facilitated with contributions from both private and public stakeholders.
>
> Public actors can support the implementation of new mobility services by showing and emphasizing the social goal of a new mobility system.
>
> Pilot projects and researching business models can reduce uncertainties regarding costs and user acceptance.

Jorritsma et al. (2021) found that in the Netherlands in order to encourage the use of shared mobility, supporting infrastructure including hubs can be implemented. Besides improving accessibility, hubs are considered to contribute to “lower carbon emissions, reduced congestion and air pollution, better accessibility and increased quality of life” (Kask et al., 2021). As a result mobility hubs have gained significant importance as a key objective in the Dutch public transport vision. The Ontwikkelagenda Toekomstbeeld OV (Ministerie van Infrastructuur en Waterstaat, 2021), in a collaboration between the Ministry of Infrastructure and Water Management, provinces and transport regions, public transport operators and the railway network provider ProRail, emphasize that the strength of hubs are in supporting the public transport network with other modes, both personal and shared. It is argued that by providing facilities for private cars and bicycles and shared modes, hubs provide sustainable door-to-door transportation in urban and rural regions. Moreover it enables individuals to choose for a life without a personal car. The three main policy directions in the development agenda for the development and improvement of hubs are (Ministerie van Infrastructuur en Waterstaat, 2021):

1. Improvement of functional quality to enable efficient and barrier free transfers for everyone.
2. Improvement of spatial quality to increase cohesion between hubs and their surroundings.
3. Scaling up to develop a multimodal hub-network and increasing capacity of existing hubs.

In Groningen and Drenthe a collective network of 57 hubs (34 in Groningen; 23 in Drenthe) was opened in 2018 (figure 9) (Reisviahub, 2023). At these hubs at least one high quality bus or train connection connects with on-demand transport. Moreover the hubs in Groningen and Drenthe serve all residents at a maximum of 15 kilometre distance from their home (Kask et al., 2021). Six of the hubs in Drenthe are located on provincial land, except for Peize which is partly owned by the local municipality. At hubs owned by the municipality, the municipality decides upon additional services and facilities. So the willingness and availability of resources of a municipality determine the activity in the hub program. In addition, when hubs only provide basic amenities like public transport connections and bicycle parking, municipalities often lack interest in developing the hub further. At the hubs owned by the province, the implementation of first and last transport facilities and services is easier because the province can agree with their own initiatives. In these cases municipalities are involved in the process but the province covers the costs and accounts for the risk in the developments (Kask et al., 2021).

Figure 9: Location and ownership of hubs in Groningen & Drenthe (Kask et al., 2021).

2.2.5. Rural MaaS

As a tool to address rural transport problems there is growing interest in using Mobility-as-a-Service (MaaS). The core elements of MaaS are summarized by Molinares and Palomares (2020) as follows: “a unique single platform (app or website), real-time information on all available modes in the city (public and private), multimodal transportation (intermodal journey planners), technological integration to plan, book and pay for mobility needs, and personalized bundled mobility packages according to user's particular requirements”. Another core element, identified from a user’s perspective is the personalisation of users’ travel needs and desires. This implies an incorporation of all transport modes, including shared modes, in an on-demand service. Users will purchase mobility service packages, or pay per trip, substituting individual ownership (Ibid.). The concept MaaS first emerged around 2014 and had an initial focus on urban transport problems like congestion, lack of parking, and excessive car use (Hult et al., 2021). By contrast, in the last years increased attention has been paid to rural MaaS. Most rural MaaS pilots conversely aim for improving accessibility of rural dwellers, specifically for people without private car access or people that wish to reduce private car dependency (Ibid). Eckhardt et al. (2020) furthermore argue that rural MaaS is based on the integration of different services and user groups, mainly relying on on-demand and sharing services.

A substantial part of studies into rural MaaS have investigated its feasibility in communities based on policy, planning and implementation. It is collectively agreed upon that the public sector should have an enabling role in the implementation of MaaS, meaning that there is need for new public policies (Smith and Hensher, 2020). However, in their reflective study of five rural MaaS pilots in Sweden, Hult et al. (2021) found that there exists a high dependency on capable and influential local organizations mainly in the roles of facilitators and ambassadors. This dependency can be disadvantageous in spatial injustice between different rural communities. Because the most marginalized areas are more likely to lack capacity to engage in innovative programs like MaaS (Hult et al., 2021). Moreover, the potential user base in rural areas is limited which results in vulnerability of services that require a critical mass, like car-sharing (Hult et al., 2021). It has also been found that the vulnerability lies in the high share of elderly with a lack of technological skills and the difficulty to change travel habits. Because of the sensitivity of MaaS to socio-demographic and cultural trends, it could be argued that in places where population density decreases, the need of making a profit should reduce (Amaral et al., 2020). By addressing the spatially specific issues and needs, MaaS can serve as a social transport service. This even might help in reducing the outmigration of rural inhabitants and eventually maintaining population levels (Amaral et al., 2020)

The implementation of MaaS in the real world is still limited. In the Netherlands the Dutch government promoted MaaS with seven pilot programmes running between 2018 and 2022 (Ministry of Infrastructure and Water Management, 2019). They stated that a minimum of 50,000 users per app is crucial in order to experience an effect and create a positive business case. One of the Dutch pilot projects runs in Groningen-Drenthe, focussing on the regional and rural context. Their goal is: "to create an affordable, future-proof, innovative and integrated mobility system that meets the needs of travellers in the provinces of Groningen and Drenthe" (Ministry of Infrastructure and Water Management, 2019). Additionally the MaaS pilot can contribute to the hub network by offering travellers the possibility to create their individual optimal trip, or journey. All existing transport options should be accessible and interconnected, including invisible options like the Hub Taxi, reserved spaces for special groups, and small-scale initiatives, some of which may be run by volunteers (Ministry of Infrastructure and Water Management, 2019). The pilot did not make any progress yet and is therefore not assessable. However, Mulley et al. (2023) in their investigation of recent experiences with MaaS in the rural context did conclude that whilst high population density is considered essential for a successful MaaS system, it seems to be less critical in rural areas based on experiences form the Netherlands. But, the level of rurality still poses challenges in achieving sustainable mobility goals.

2.2.6. The Dutch (rural) context

The current availability of shared cars in the Netherlands is primarily concentrated in highly urbanized areas, where also the most significant growth in usage is occurring. In these highly urbanized regions, 2% of the total number of cars are shared cars (Kennisinstituut voor Mobiliteitsbeleid, 2019). According to Jorritsma et al. (2015) roughly 1% of adults participate in some form of car-sharing. Besides P2P sharing, B2C or B2B sharing, local community sharing, or informal car-sharing, is commonly used by Dutch individuals; between 2017 and 2020, 24% of the population have informally shared a car (Kennisinstituut voor Mobiliteitsbeleid, 2019).

Figure 10 shows the spatial locations of adoption of P2P and B2C car-sharing in the Netherlands (Meelen et al., 2019). From the figure it becomes evident that B2C sharing is mainly limited to bigger cities, especially centered around Amsterdam. On the other hand, P2P sharing is more widely adopted, also to be found in more rural areas. This can be explained by the fact that it is difficult for B2C providers to profit from shared cars in low density regions (Münzel et al., 2019). In Drenthe, as to be seen on figure x, the adoption of P2P sharing is scattered but the availability of B2C shared cars is limited to the capital city Assen where Greenwheels provides three cars (Greenwheels, 2023). Recently, shared cars at 13 different hubs and village centres in Groningen and the North of Drenthe are provided as a pilot project. Specifically to test how shared cars can contribute to a sustainable and accessible rural region (Provincie Drenthe, 2022).

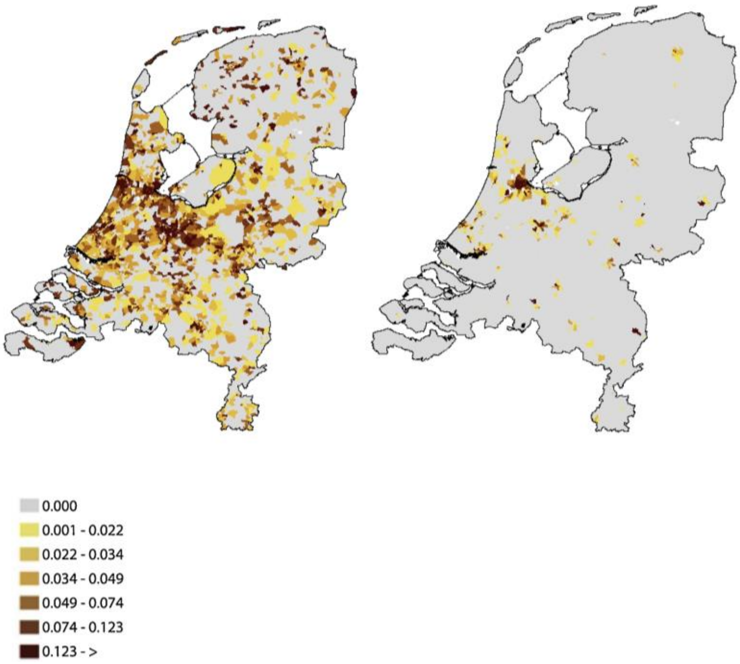

Figure 10: Adoption of P2P (left) and B2C (right) car-sharing per 100 inhabitants in the Netherlands (Meelen et al., 2019).

2.2.6.1. Adoption intention

Existing research into electric car-sharing service (ECS) users and potential adopters in the Netherlands generated three main influential factors; psychological variables, socio-demographic variables and transport related variables (Curtale & Liao, 2021).

The most important psychological factor affecting adoption intention is social influence, meaning that an individuals' belief or action with regards to ECS is influenced by related individuals such as family or friends. Second it is found that the degree to which ECS is believed to satisfy mobility needs and the environmental friendliness of an individual determines adoption intention. This ties in with the earlier mentioned perceived benefits and the effect of environmental attitude on individuals' sharing intention (Acheampong & Siiba, 2019). On the other hand, the results of Curtale & Liao (2021) with regards to the ease and intuitive use (effort expectancy) strike with earlier research of Fleury et al. (2017) in France who found that the effort expectancy was the most influential factor in intention to use ECS.

With regards to socio-demographic variables, Curtale & Liao (2021) found that the gender differences in adoption intention (as discussed earlier) can be explained by lower levels of social influence and effort expectancy of females. Furthermore higher educated people appeared to be more intended to share because of a more positive environmental attitude. This is in line with Münzel et al. (2019) who studied car-sharing user motives and characteristics in the Netherlands. They also found that ECS are most popular among individuals with high levels of educational attainment and a positive attitude towards the environment. However the results of Münzel et al (2019) show that gender and income do not have significant influence on adoption intention.

Concerning transport related variables, it has been found that car owners have lower intention to share due to lower perceived benefits (Curtale & Liao., 2021). Therefore Münzel et al. (2019) argue that intended car-sharing users have lower car-dependency. Curtale & Liao. (2021) yield concerns about the introduction of ECS for long distance trips because they found negative impacts of satisfaction on longer trips consequently leading to lower behavioural sharing intention. This can be explained by a lack of confidence driving an electric vehicle for a longer period of time. Lastly, previous experience with car-sharing positively influences adoption intention.

A balanced demand and supply system is needed for a successful functioning B2C or P2P system (Münzel et al., 2019). Therefore the difference in B2C and P2P users will be elaborated on. Users with higher income and educational attainment are more likely to choose B2B sharing, which is a more convenient and expensive system. On the other hand the less expensive P2P service is more popular amongst lower income individuals (Münzel et al., 2019). In addition, not owning a car and thus being more public-transport oriented are mostly choosing B2C car-sharing. With regards to the purpose of use, P2P systems seem to be used more for special occasions, while B2C users incorporate car-sharing into their regular routines. (Münzel et al., 2019). All in all, the differences in personal characteristics among adopters appear to be minimal, while the usage patterns significantly differ between B2C and P2P car-sharing.

2.3. Conceptual model

It is proved that shared mobility is having notable impacts in cities by enhancing transport accessibility, increasing multi-modality, reducing car ownership and providing new ways to access goods and services (Shaheen, 2016). Moreover it is found that shared mobility can play an important role in serving low-income populations without car access or physically challenged individuals (Jiao and Wang, 2019). Specifically car-sharing is successful because it provides enhanced mobility or sufficient mobility at reduced costs (Cohen & Shaheen, 2018). When socio-demographics and land-use is modelled, shared vehicles could also enhance mobility options for rural populations. An essential factor for shared mobility in areas with low and dispersed demand is the collaboration between public and private actors (Rongen et al., 2022). Additionally appropriate policy and planning guidance is needed to assure that shared mobility will serve its goal (Jiao and Wang, 2019).

Following the concepts and theories explained in the theoretical framework, a conceptual model is created (figure 11).

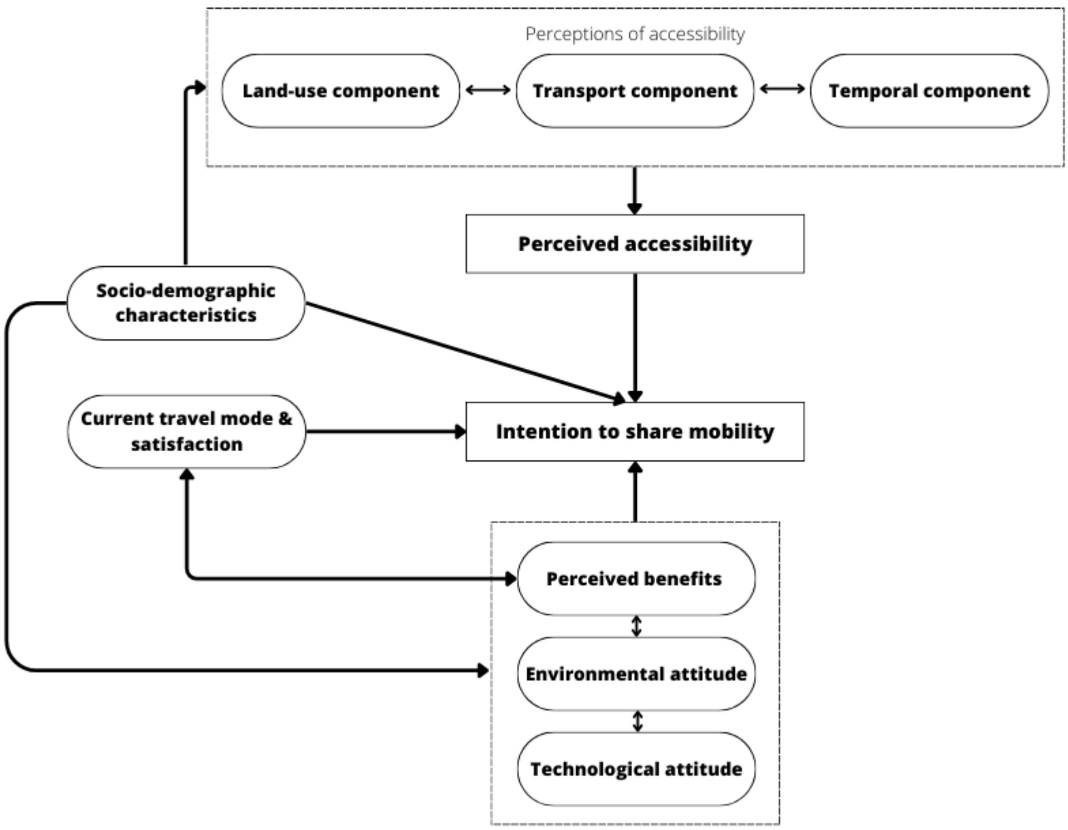

Figure 11: Conceptual model.

Accessibility consists of three components; land-use, transport and temporal. These components are perceived by the individual leading to one's perceived accessibility. How one perceives the three accessibility components is based on their socio-demographic characteristics. In addition, based on the literature review it is considered that one's intention to share mobility is influenced by how they perceive their accessibility. Low perceived accessibility would increase one's intention to share mobility, whereas high perceived accessibility would decrease one's intention to share mobility. On the other hand, socio-demographic characteristics also influence intention to share mobility. As discussed earlier for example, younger, better-educated and more wealthy individuals are more interested in shared modes of transportation. Another directly influencing factor in intention to share mobility is the current travel mode and satisfaction with that mode. Technological attitude, environmental attitude and perceived benefits of sharing together influence one's intention to share mobility. Moreover, as argued before there is a relationship between technological attitude, environmental attitude and perceived benefits. In addition, socio-demographic characteristics influence the three aforementioned factors as well. Lastly it is hypothesized that satisfaction with current mode of transport directly influences the perceived benefits of sharing. Because the gap between experienced and expected travel mode choice and satisfaction could be a reference point for individuals to evaluate the perceived benefits of sharing. The other way around, perceived benefits of sharing determine the travel mode choice and satisfaction with that mode.

3. Methodology

3.1. Research design

The aim of this research was to explore the concept of car-sharing in rural areas, which could possibly contribute to the accessibility of rural dwellers. Moreover, it was aimed to get insight into the determining factors in citizens' shared mobility adoption intentions. Given the aim and in order to answer the main research question; "How do perceived accessibility and attitudes towards sharing affect car-sharing as a mobility solution for rural areas in Drenthe?", this thesis uses a quantitative multiple-case study design. Empirical quantitative data on perceived accessibility and shared mobility adoption intention of the population living in rural Drenthe is collected through the use of questionnaires (3.2. Questionnaire design). Within this research the questionnaire is a useful technique in collecting a relatively large amount of data on intentions and attitudes of a group of people. Moreover, a quantitative research approach allows for assessing the relationship between the variables of interest within this study (Creswell, 2014). The variables of interest could not have been generated form interview data. Therefore qualitative data, which would get in-depth information on personal meanings and experiences, was not chosen. Secondary data on perceived accessibility or rural residents' sharing intention was not available.

The questionnaires are spread through six rural villages in Drenthe. Rurality is a relative and subjective concept and therefore the classification of rurality and the subsequential case selection will be elaborated on (3.3. Data collection & case context). Multiple-case study design will provide in-depth information in the real-life context whilst allowing for analysing differences and similarities between cases (Hunziker & Blankenagel, 2021). Generated data is analysed using descriptive statistics as well as multiple statistical tests suitable for answering the research question (3.4. Data analysis). Chapter 3.4. elaborates on the data preparation and statistical analyses in this research. In chapter 3.5. the quality of this research design is discussed, as well as the concerned ethics and the position of the researcher within this study.

3.2. Questionnaire design

Firstly, after a short introduction to the study, participants were asked about their socio-demographic characteristics including age, gender, educational attainment, employment, household size, the number of privately owned cars, place of residency and the possession of a driver's license.

To explore individuals' current travel characteristics, they were asked to indicate their main mode of daily transport, their satisfaction with that mode and the average one-way travel time.

Perceived accessibility is measured with the 'Perceived Accessibility Scale', PAC constructed by Lättman et al. (2016). The measurement instrument consists of four items (table 1) that together measure "overall perceived accessibility of daily travel, regardless of transport mode, or combination of modes" (Lättman, 2018). Participants are asked to rate the four items of perceived accessibility on a 7-Point Likert scale, ranging from 1= Completely disagree to 7= Completely agree. The perceived accessibility index is retrieved by calculating the mean from the four rated items.

Perceived accessibility items
Considering how I travel today it is easy to do my daily activities
Considering how I travel today I am able to live my life as I want to
Considering how I travel today I am able to do all activities I prefer
Access to my preferred activities is satisfying considering how I travel today

Table 1: Measurement items of perceived accessibility.

To measure respondents' intention to share mobility this study made use of survey items constructed by Acheampong & Siiba (2019). This structured survey is based on modelled determinants for car-sharing intentions. After a description of the (car)-sharing concept the second part of the survey asks questions about the perceived benefits of sharing, environmental and technological attitudes and trust in the car-sharing innovation. Trust in this context is about "whether or not they trust that strangers with whom they would car-share, will take good care of the cars to ensure best possible service quality" (Acheampong & Siiba, 2019). Perceived benefits, environmental attitudes, technological attitudes and trust are presented on a 5-Point Likert scale ranging from 1= Strongly disagree to 5= Strongly agree. In the last part respondents' intentions to share mobility are explored further by first asking whether or not they are interested in sharing mobility if this option is available in their village. This is rated on a 5-point scale from 1: Definitely not, to 5: Absolutely yes. Moreover respondents were asked when they would use the service, what service they would use and why they would use it.

The full questionnaire design is to be read in Appendix 1.

3.3. Data collection & case context

The cases covered in this research consist of six rural villages in Drenthe. Data in these villages is collected through questionnaires. The data collection took place between May 31 and June 19. Participants are recruited in different ways to enlarge response and increase the representativity of the sample. Invites for the questionnaire through a scannable QR-code were spread through letterboxes, distributed in public buildings like townhouses and sports halls and online via village/neighbourhood associations. Within each village the letterbox invites are distributed randomly to get a diversified sample. The streets have been randomly selected using a random generator. Within the selected streets, systematic random sampling was used in which every 4th house received a questionnaire invite. A limitation in this sampling method was the required technological skills to fill in the online survey. Moreover by randomly selecting public buildings and residences, potential willing respondents are not included in the sample. The online survey software platform 'Qualtrics' was used to collect and store the data. After the data collection was closed, the data was transferred to IBM SPSS Statistics Data Editor to be prepared for the analysis of the results.

3.3.1. Classification of the 'rural'.

Rurality is classified differently around the world. The classification of an area as urban or rural is dependent on the criteria used. Eurostat defines a rural area as; clusters of contiguous grid cells of 1 km2 with a density of at least 300 inhabitants per km2 and a total population of 5,000 (Mounce et al., 2020). Rural regions can then be classified as 'predominantly rural', if the share of population living in rural areas is higher than 50%, or as 'intermediate' if the share of population living in rural areas is between 20% and 50% (Ibid.). In Europe generally speaking the population tends to centre around towns and cities leaving rural areas more sparsely populated. Besides population size and distribution, transport accessibility can also be used to measure rurality (Scottisch government, 2018). The classification that follows from this approach is; 1; Accessible small towns: Settlements of 3000–9999 people, and within a 30-min drive time of a settlement of 10,000 or more people.2; Remote Small Towns: Settlements of 3,000 to 9,999 people, and with a drive time of over 30 min to any settlement of 10,000 or more people. 3: Accessible Rural Areas; Areas with a population of less than 3,000 people, and within a 30-min drive time of a settlement of 10,000 or more. 4: Remote Rural Areas: Areas with a population of less than 3,000 people, and with a drive time of over 30 min to a settlement of 10,000 or more. However, this classification is dependent on the proximity of areas by car drive-time, ignoring people living in rural areas without a car, depending on public transport.

The rural area of the Netherlands comprises of 66.6% land surface and 32.1% of the population. Steenbekkers & Vermeij (2013) classify the following 4 types of villages based on the distance to the city and the population density of the village; ‘big village nearby the city’, ‘small village nearby the city’, ‘big remote village’ and ‘small remote village’. It is argued that big villages nearby the city benefit from facilities of the cities whilst also encounter the problems of a city. Small villages nearby the city on the other hand benefit from the close proximity of facilities as well as the calmness and solidarity of a village. Remote villages however often struggle with population decline, ageing and the disappearance of services (Simon et al., 2007). The distribution of cities and the classified rural areas of the Netherlands is to be seen in figure 12.

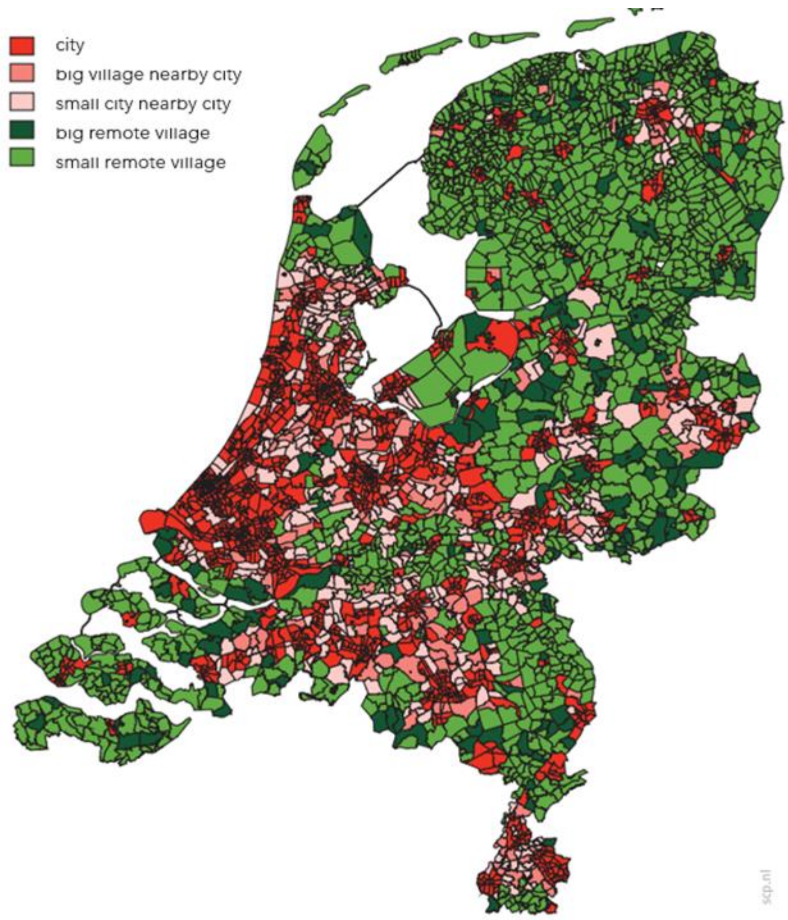

Figure 12: Urbanity the Netherlands (CBS (maatwerk stedelijkheid 2014) en Goudappel Co eng (2009)) – edited.

Zooming in to Drenthe (figure 13) it becomes evident that on the basis of the classification by Steenbekkers & Vermeij (2013) there are five cities Assen, Emmen, Meppel, Hoogeveen en Roden. In the North of the province, there are some ‘small villages nearby the city’ as well as some ‘big villages nearby the city’ (in this case the city of Groningen). In addition there are a few ‘big remote villages’ but Drenthe mainly consists of ‘small remote villages’.

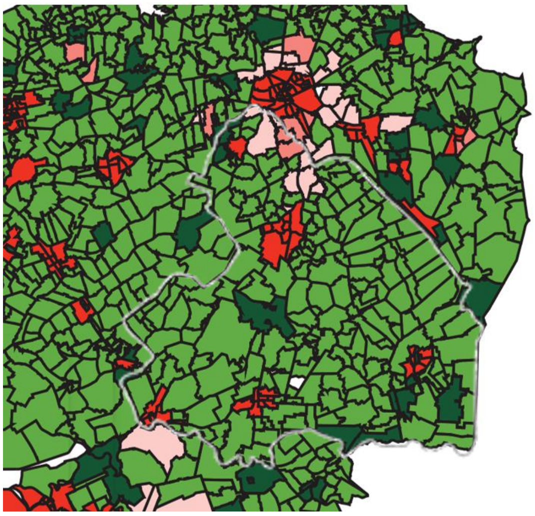

Figure 13: Urbanity Drenthe (CBS (maatwerk stedelijkheid 2014) en Goudappel Co eng (2009)) – edited.

3.3.2. Case selection

Based on the classification of Steenbekkers & Vermeij (2013) and the distribution of this classification in Drenthe, discussed in the previous paragraph, three 'small remote villages', Fluitenberg, Schoonoord and Rolde, and three 'big remote villages', Nieuw-Amsterdam, Beilen and Klazienaveen have been selected (table 2). 'Big villages nearby the city' and 'small villages nearby the city' are left out of this research because in these cases the accessibility to the city and the facilities by public transport or car is relatively high. Research by Vliegen et al. (2006) has shown that 90% of the 'small remote villages' have a population size with less than 4000 inhabitants. For 'big remote villages' the population size is in 72% of the cases between 4000 and 13.000 inhabitants. Roughly the boundary between the two remote villages is at 5000 inhabitants and an address density of 500 per km2.

		Municipality	**Population size (year 2022)**	**Addresses per km2 (year 2022)**	**Transport HUB modes**
	Small remote village		*Max. 5000*	*Max. 500*	
1	Fluitenberg	Hoogeveen	786	51	/
2	Schoonoord	Coevorden	2.043	65	/
3	Rolde	Aa en Hunze	3.783	288	Bus, taxi
	Big remote village		*Ca. 5000-13.000*	*Ca. 500-1000*	
4	Nieuw-Amsterdam	Emmen	4.710	607	Train, bus, taxi
5	Beilen	Midden-Drenthe	11.476	283	Train, bus, taxi
6	Klazienaveen	Emmen	11.995	847	Bus, taxi

Table 2: Case characteristics of studied cases.

It is chosen to select cases with the greatest possible municipal variation. Fluitenberg is located in the municipality Hoogeveen, Schoonoord in the municipality Coevorden and Rolde in Aa en Hunze. With regards to the big remote villages there were 5 optional cases, therefore the 3 most centred villages were selected. Nieuw-Amsterdam and Klazienaveen are both part of the municipality Emmen and Beilen of Midden-Drenthe. The ‘Transport HUB modes’ in table 2 indicate the modes of public transport available at the HUB in the village. In Fluitenberg and Schoonoord there is no transport HUB present. The geographical distribution of the cases is mapped out in figure 14.

Figure 14: Geographical location of studied cases.

3.4. Data analysis

3.4.1. Data preparation

Before running statistical tests, the raw data has been prepared for analysis. Data preparation consisted of 1) filtering invalid and incomplete cases, 2)combing the three small villages and three big villages in a new categorical variable, 3)calculating perceived accessibility, perceived benefits, environmental attitude and technological attitude, and 4)removing and recoding a number of socio-demographic variables.

First, all invalid and incomplete cases are removed from the dataset. Invalid cases are regarded as cases that responded a village of residency other than Fluitenberg, Schoonoord, Rolde Nieuw-

Amsterdam, Beilen or Klazienaveen. Incomplete cases are considered as cases of which besides socio-demographic items and or travel characteristics no further questionnaire items are completed.

Second, a new variable 'Village Size' was computed, combining the three small remote villages in one category and the three big remote villages in another category. Combining the multiple cases into two categories allowed for cross-case analyses involving exploration of differences and similarities at the same time increasing the generalizability.

Third, perceived accessibility is calculated by the mean of the four response items and expressed in a new variable 'PAC', Perceived Accessibility Scale (Lättman et al., 2016). PAC is expressed in a number from 1 to 7 with 7 being the highest. The responses to the 5-Point Likert scale items on perceived benefits (PB), environmental attitude (EA) and technological attitude (TA) are all calculated by the mean of the sequential 9, 3 and 2 response items. The variables are expressed in a number from 1 to 5 with 5 being the highest. All four new variables have been tested on their internal consistency.

Fourth, the socio-demographic items that were needed in the statistical analysis are recoded. The variables age and gender appeared to be explaining factors in sharing intention and therefore needed recoding in order to suit the statistical test. For age the groups '0-18' and '<80' are removed because of too small group sizes. Gender was recoded into a binominal variable including 'male' and 'female' because group sizes 'other' and prefer not to answer were too small.

3.4.2. Statistical analysis

IBM SPSS Statistics 26 was used to analyse the prepared data. To explore potential differences in perceived accessibility, first the association between perceived accessibility and village size was tested. Second, the difference in perceived accessibility between transport mode and satisfaction was tested. Thereafter, sharing intention was tested with village size, transport mode and satisfaction and socio-demographic characteristics to find potential relationships. Lastly, to observe how perceived accessibility, perceived benefits, environmental attitude and technological attitude are associated with sharing intention, ordinal regression was performed. Village size and socio-demographic variables were then added to see potential changes in sharing intention.

For perceived accessibility the Cronbach's alpha is computed to check the internal consistency of the four 7-Point Likert scale items. The mean PAC is calculated and further explored by the use of multiple t-tests to determine potential differences per village size, main mode of transport and satisfaction with main mode of transport. To examine potential differences between the main mode of transport and satisfaction a Chi-Square test is performed.

The results of respondents' attitudes towards car-sharing, consisting of perceived benefits, environmental attitude and technological attitude are tested on their internal consistency and descriptively presented in a table. The questions on trust and innovation are also included in the table. Respondents' intention to make use of car-sharing is first visualised in a graph. To explore respondents sharing intentions further, multiple graphs representing potential sharing characteristics are set out and discussed.

Building on the explored perceived accessibility, attitudinal stance and sharing intentions, additional insights through the estimation of a multivariate ordinal regression model are proceeded, using the Likert-scale response of intention to share as the dependent variable. The model enables better understanding of which variables are most influential in intention to share, while controlling for the simultaneous influence of other variables. The ordinal regression model is estimated using first, attitudinal variables perceived accessibility, perceived benefits, environmental attitude and technological attitude, then the contextual variable village size and thereafter socio-demographic variables. Variables with an ordinal or ratio scale are added as covariates and categorical variables as factors.

3.5. Quality and ethical considerations

The thesis aimed for an unbiased representation of the perceived accessibility and sharing intention of residents of Fluitenberg, Schoonoord, Rolde, Nieuw-Amsterdam, Beilen and Klazienaveen. To ensure content validity of the survey, questionnaire items on perceived accessibility and sharing intentions of previously conducted research were used. In addition, the questionnaire was tested by amongst others the thesis supervisor to make sure that the wording of questions was appropriate and did not include any sensitive, stressing or offending phrasing. With regards to external validity, for each village at least 30 respondents are generated. However, because of unique village contexts in Drenthe and the relatively limited sample size, generalization of findings is handled with caution.

For the recruitment of survey respondents, all invites have been spread online or through printed sheets. This way participation was able at any preferred time and completely voluntary. The diverse data collection method also enables greater representativity of the sample. After an introduction to the study, participants of the survey were promised anonymity and confidentiality. Moreover, they were able to quit the questionnaire at any time. Skip-logic was employed to only present relevant questions based on their answer.

The authors' position within the research lies in the interest of rural accessibility because of personal rural residency, specifically in Drenthe. This insider position has been beneficial in participant access and understanding the research context. Any potential bias was removed by the diverse cases and participant recruitment. On the other hand the topic of shared mobility was relatively new to the author minimizing the statement of assumptions related to the research topic, design and process.

4. Results

The total number of survey respondents was 276. Cases who only responded to the socio-demographic items are left out of the analysis. Cases that reported to live in another place of residency as one of the six cases of this research are left out of the data set as well. In total this left 241 valid cases. Not all 241 cases completed the entire survey but did respond up to and including the PAC question items. Therefore these cases will also be included. 224 respondents completed the survey entirely.

4.1. Individual characteristics

Descriptive statistics of the individual characteristics of survey respondents is presented in table 3. Around 10% of the respondents live in Fluitenberg, 19% in Schoonoord, 32% in Rolde, 11% in Nieuw-Amsterdam, 14% in Beilen and 14% in Klazienaveen. So divided in village size, 61% lives in a small remote village and 39% lives in a big remote village. Only 2% of the respondents is younger then 18 and there are no responses in the group of 80 or older. This is not regarded as problematic in this research because individuals in the groups 0-18 and <80 are not inclined to have a driver's license and are therefore to a small extent able to make use of car-sharing. Most daily commuters are between the age of 18 and 65. However, a relatively small percentage of survey respondents (6%) is between the age of 65 and 80. So the sample is missing a part of the population that possibly relates to the problem of accessibility and social exclusion in rural areas. As a consequence, results might be affected.

Residency	Fluitenberg	10%
	Schoonoord	19%
	Rolde	32%
	Nieuw-Amsterdam	11%
	Beilen	14%
	Klazienaveen	14%
Gender	Male	41%
	Female	58%
	Prefer not to answer	1%
Age	0-18	2%
	18-25	28%
	25-40	23%
	40-65	41%
	65-80	6%
	<80	0%
Household size (including respondent)	1	11%
	2	34%
	3	21%
	4	26%
	5>	9%
Educational attainment	No schooling completed	0%

	High school graduate	10%
	MBO graduate	43%
	HBO graduate	37%
	WO graduate	10%
Employment	Employed	67%
	Not employed	6%
	Student	12%
	Retired	6%
	ZZP'er	8%
	Prefer not to answer	1%
Driver licence	Yes	96%
	No	4%
Car ownership in household	None	5%
	1	33%
	2	48%
	3>	14%
Current travel mode	Car	64%
	Public transport	10%
	Bike	20%
	Walking	3%
	Other	3%
Satisfied with current travel mode	Yes	93%
	No	7%
Current ravel time	<30 min	58%
	30 min-1hr	34%
	1hr-2hrs	6%
	>2hrs	2%
Knowledge shared mobility	Yes	47%
	A little	35%
	No	18%

Table 3: Characteristics of survey respondents (n=241).

4.2. Perceived accessibility

For the four items of the PAC-index a Cronbach's Alpha is computed to test their internal consistency. The calculated value of the Cronbach's Alpha is 0.881. Table 4 presents the mean, standard deviation and the α if the item is deleted.

Item	Mean	Standard deviation	Cronbach's Alpha if item deleted
"Considering how I travel today…"			
It is easy to do my daily activities	6.09	1.33	0.89
I am able to live my life as I want to	6.02	1.28	0.87
I am able to do all activities I prefer	5.91	1.32	0.86
Access to my preferred activities is satisfying	6.04	1.10	0.89

Table 4: Descriptive statistics change in Cronbach's alpha for items included in the PAC-Index (N=241, α =0.881).

Based on the sample the overall calculated mean perceived accessibility of the 6 villages is 6.01 out of 7 (N=241) meaning that accessibility is evaluated high. This result is in line with previous research of Pot et al. (2021), they report a PAC-index of 5.82 in Dutch rural areas. There is a strong negative skew (-1.95) which indicates that relatively many outliers with low perceived accessibility. 9.1% of the sample reported a PAC score lower or equal to 4.5.
Table 5 shows the difference in PAC between small remote villages and big remote villages. The difference in mean PAC between small remote village (M = 6.0278; SD = 1.13707) and big remote village (M = 5.9922; SD = 1.01077) was not tested significant (t (238) = 0.248; p > .05).

PAC	Village size	N	Mean	Standard deviation
	Small	144	6.03	1.14
	Big	96	5.99	1.01

Table 5: PAC index for different village sizes (N=240).

The small remote villages in this case have less spatial, calculated accessibility compared to big remote villages. For example when taking into account public transport options like bus stops and the presence of a train station. But the results show relatively similar PAC-indexes (6.03; 5.99) between the different village sizes. Considering earlier study by Lättman et al. (2016) the difference between spatial accessibility and perceived accessibility is mitigated by residential self-selection. It is shown that the selection of a small remote village or big remote village as place of residency matches one's travel needs, desires and attitudes.

On the other hand, there is found a statistically significant difference in PAC for main mode of transport (F(4)=12.22, p < .001). A post-hoc test revealed significant pairwise differences between the car and public transport with an average difference in PAC of 1.03 (p < .001), car and bicycle with an average difference in PAC of 0.55 (p < .001), car and walking with an average difference in PAC of 1.34 (p < .001) and public transport and bicycle with an average difference in PAC of -0.75 (p < .001). Figure 15 displays the plotted means and standard errors of perceived accessibility per main mode of transport; car 6.31, public transport 5.01, bicycle 5.76, walking 4.95 and scooter 5.64. The significant differences in PAC between the car and other modes of transport can be explained by the high car dependency in rural regions. Individuals mainly travelling by public transport, bicycle or foot report significantly lower perceived accessibility. This is in line with previous arguments saying a compensating factor for the lack of access to opportunities is car mobility (Pot et al. 2023).

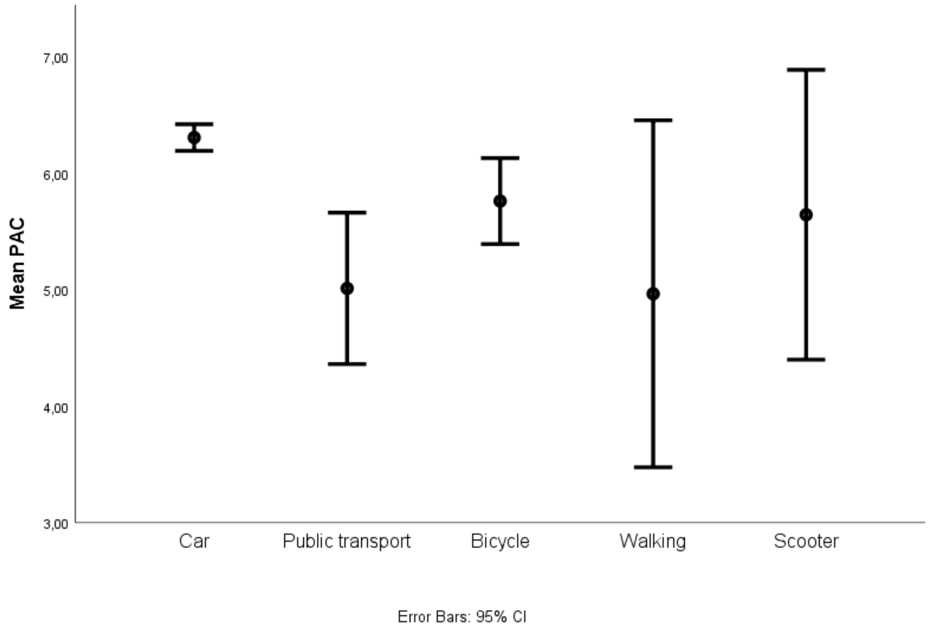

Figure 15: Plotted means and standard errors PAC per main mode of transport (N=241).

With regards to satisfaction with current mode of transport, 93% of the respondents reported to be satisfied and 9% is dissatisfied. Table 6 shows the difference in PAC between satisfied and dissatisfied individuals. The difference in mean PAC between satisfied individuals (M = 6.0973; SD = 0.99103) and dissatisfied individuals (M = 4.7667; SD = 1.60765) was tested significant (t (241) = 4.811; p < .001).

The survey results further show that public transport users are more likely to be dissatisfied compared to car users, as about 21% of public transport users compared to 5% of car users reported to be not satisfied with this mode of travel. This relationship between the before mentioned variables is tested significant (X^2 (1, n=188) = 7.2, p= .007; Cramer's V effect size'=0.195, p=.007). Furthermore, odds ratio estimation reveals that public transport users are 4.5 times more likely to be dissatisfied with their transport mode compared to car users. These results are in line with previous research that found that car usage correlates positively with higher levels of satisfaction and non-car users are more likely to be dissatisfied with the quality of existing public transport services (Acheampong & Siiba, 2019).

PAC	Satisfied with current mode	N	Mean	Standard deviation
	Yes	226	6.10	0.99
	No	15	4.77	1.61

Table 6: PAC index for satisfaction with current mode of transport (N=241).

4.3. Attitudes and intention to share mobility

In this section the results of the responses to the indicator items used to measure perceived benefits, environmental attitude and technological attitude are discussed. Table 7 shows a descriptive summary of the measured items based on the five-point Likert scale. Thereafter participants' intention to share mobility and further information on their expected use is presented and visualised in graphs.

%	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Perceived benefits (α=0.843)					
Good alternative to owning a car	14,3	16,7	20	40,5	8,6
Could reduce environmental pollution	6,7	8,1	19,5	43,8	21,9
Sharing would be safe	4,8	15,7	38,1	29	12,4
Sharing would be the fastest option to travel	24,8	29,5	25,2	15,7	4,8
Sharing would be flexible	11,9	15,2	22,9	33,3	16,7
Sharing would reduce the need for a personal vehicle	13,3	14,8	14,8	45,2	11,9
Sharing could reduce spending on transport	4,3	11,0	12,4	49,0	23,3
Sharing would be suitable for work trips	19	18,6	21,9	33,8	6,7
Sharing would be suitable for non-work trips	10,5	13,8	15,2	45,2	15,2
Environmental attitude (α=0.837)					
I am concerned about the environmental destruction and climate change	3,8	5,2	11,4	45,7	33,8
I am willing to spend a bit more to buy product or use a service that is more environmentally friendly	12,4	19,0	25,7	32,9	10,0
I would change my behaviour based on concern for the environment	11,4	16,2	22,9	40,5	9,0
Technological attitude (α=0.867)					
I think technology is generally a good thing	2,4	5,7	20,0	53,3	18,6
I am excited about the possibilities offered by new technologies in solving societal challenges	1,9	6,7	21,0	45,2	25,2
Others					
I can trust car-sharing with other people/stangers	10,5	31,4	28,1	26,7	3,3
I think car-sharing is innovative transport solution	9,0	14,3	25,7	42,9	8,1

Table 7: Summary of participants' responses to Likert scale items in the survey (N=255).

With regards to perceived benefits, results show that 40.5% of the respondents find that sharing would be a good alternative to owning a car. The majority of the respondents agree that sharing could reduce environmental pollution (43,8%) and that it would reduce the need for a personal vehicle (45,2%). Moreover, 49% of the respondents agree that sharing could reduce spending on transport. With respect to safety the majority of respondents have a neutral opinion. Most respondents disagree (29,5%) to strongly disagree (24,8%) that sharing would be the fastest option to travel. But the majority, 33,3% agrees that it is a flexible way of transport. For the different trip purposes respondents find sharing more suitable for non-work trips (60,4% agrees) compared to work trips (40,1% agrees).

For the environmental attitude of participants, 79,5% agreed to be concerned about the environmental destruction and climate change. But 42,9% are only willing to spend a bit more to buy a product or use a service that is more environmentally friendly. The majority of the respondents (40,5% agrees and 9,0% strongly agrees) would change their behaviour based on concern for the environment.

Lastly the majority of the respondents, namely 31,4%, disagrees with the statement: 'I am convinced that people handle car-sharing properly'. But 42,9% agree that car-sharing is an innovative transport solution.

Overall the results show that the majority of respondents perceive car-sharing as being a good alternative for car ownership that could bring positive benefits. Moreover respondents have a relatively positive environmental and technological attitude. The overall calculated means of perceived benefits, environmental attitude and technological attitude are to be read in table 8 below.

Item	Mean	Min.	Max.
Perceived benefits	3.24	2.46	3.76
Environmental attitude	3.43	3.10	4.00
Technological attitude	3.83	3.80	3.90

Table 8: Calculated mean of five-point Likert scale items including minimum and maximum value (N=210).

After the elicitation of respondents perceived benefits and attitudes towards the environment and technology, they were asked to indicate their interest in car-sharing if it would be available in their residential village or nearby their residential village. The results are presented in figure 16. Only 6% reported to be interested in car-sharing and 20% of the respondents will probably use it. 36% will not use car-sharing and 24% will probably not use it. Finally 14% of the respondents don't know whether or not they would use car-sharing. The respondents that reported 'yes', 'probably', 'I don't know' or 'probably not' were asked follow up questions about their intended use of car-sharing.

Figure 17 shows the results of the timeframe in which respondents would use car-sharing. 31,10% would use car-sharing within 1 year, 35,80% in 2 to 5 years and 32,10% would wait longer and use it in 5 years or more. With regards to the location of car-sharing systems (figure 18), the majority of the respondents would walk or cycle a maximum of 10 minutes to the place where they could use a shared car. 34,3% would only use car-sharing if it is available within 5 minutes by foot or bike. Then respondents were asked in what system of sharing they would be interested in the most (figure 19). An equal proportion of respondents (37,30%) would use a station-based system or a free-floating system. 25,4% would join a P2P sharing system. Furthermore, the majority of survey respondents (88%) would use car-sharing at day time, between 06.00 and 18.00.

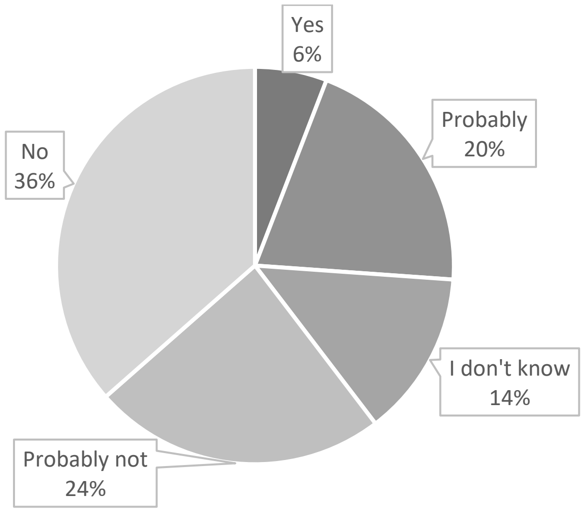

Figure 16: Intention to share mobility if available in or nearby village (N=210).

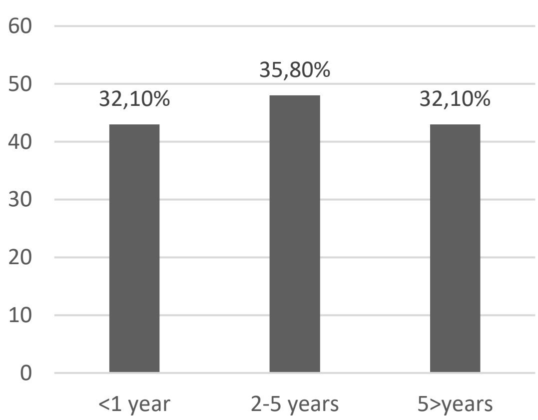

Figure 17: Timeframe of intended use (N=134).

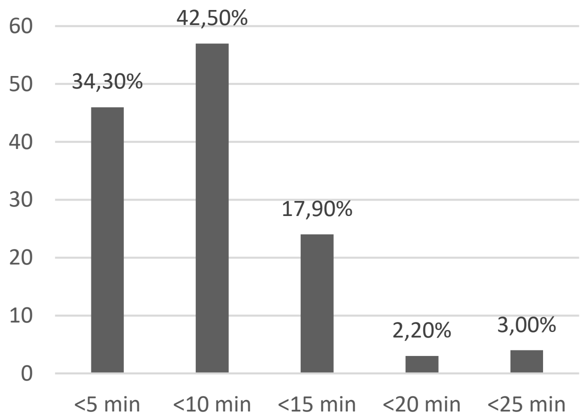

Figure 18: Max. walking/cycling time to a shared car (N=134).

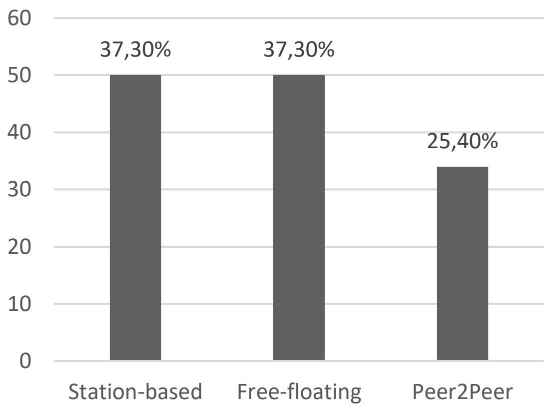

Figure 19: Intended type of car-sharing system to use (N=134).

The reasons for respondents to make use of car-sharing are shown in figure 20. The large majority of respondents, 50,70%, would use car-sharing so that they do not have to own a private car. Then the following largest proportion of respondents, 32,80% would share because of sustainability reasons. Only 7,5% because of decreased travel time and 2,2% for enjoyment. Other mentioned reasons to use car-sharing are if their privately owned car is occupied by a fellow inmate (mentioned 3 times), to change to owning 1 car instead of 2 (mentioned twice) or for financial benefits (mentioned twice).

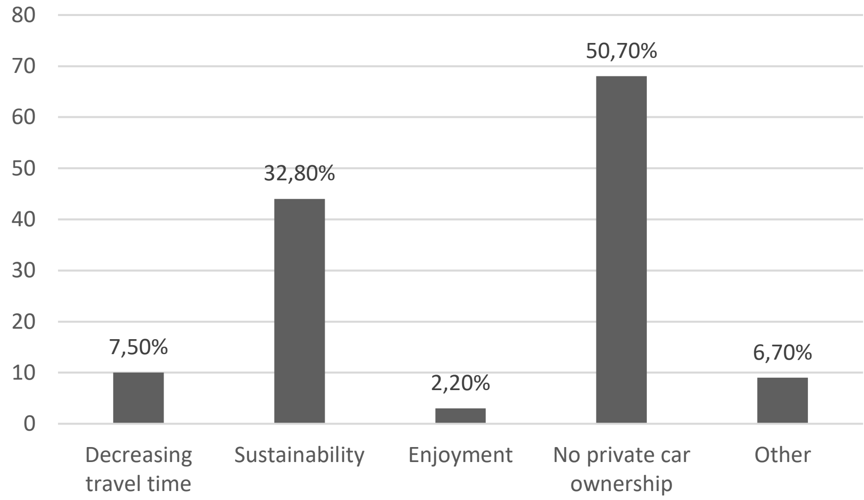

Figure 20: Main reason for making use of car-sharing (N=134).

4.4. Influencing factors for intention to share

Following the conceptual model, first the socio-demographic items and travel characteristics (listed in table 10) are tested on their relationship with intention to make use of car-sharing. A chi-square test of independence was performed to examine the relationship between village size (Small remote village; Big remote village) and the intention to share mobility. The relationship between these two variables was tested significant, X^2 (1, n=224) = 11.48, *p*= .001. Moreover the relationship between age and intention to share was also tested significant (X^2 (16, n=210) = 35.17, *p*= .004). Lastly there is found a significant relationship between gender and intention to share (X^2 (8, n=210) = 19.69, *p*= .012). For all other socio-demographic characteristics and travel characteristics no significant relationships with intention to share mobility are found. How the aforementioned significant variables correlate to sharing intention, is tested using multivariate ordinal logistic regression.

Before performing ordinal logistic regression, the independent variables are tested for multicollinearity. Firstly potential correlations are looked for using Pearson and Spearman correlation. Results show that none of the independent variables show problematic correlations. Next the collinearity statistics are shown in table 9. Following the general assumption that multicollinearity might exist with Tolerance below .25 and Variance Inflation Factor above 4, the variables in this research do not show problematic collinearity.

Model	Tolerance	VIF
Age	.815	1.227
Gender	.855	1.171
Village size	.946	1.058
PAC	.896	1.116
PB	.783	1.116
EA	.735	1.277
TA	.778	1.285

Table 9: Tolerance and Variable Inflation Factor values.

Variable	Description	Expression
Intention to share (ITS)	Intention to use car-sharing if it would be available in or nearby village of residency	No, probably not, I don't know, probably, yes
Age	Age in groups	0-18 18-25 25-40 40-65 65-80 80>
Gender	Gender	Male/female
Village size	Village size divided into small remote village and big remote village	Small/big
Perceived accessibility (PAC)	Degree to which respondents experience a adequate level of accessibility	Number from 1 to 7
Perceived benefits (PB)	Level of positive perceptions about the likely benefits of car-sharing	Number from 1 to 5
Environmental attitude (EA)	Degree to which respondents have a environmental friendly attitude	Number from 1 to 5
Technological attitude (TA)	Degree to which respondents have a positive technological attitude	Number from 1 to 5

Table 10: Dependent and independent variables in regression model.

	Model 1 DV=ITS	Model 2 DV=ITS	Model 3 DV=ITS
PAC	-.178 (.132)	-.178 (.132)	-.138 (.138)
PB	1.872 (.249)***	1.887 (.250)***	1.800 (.258)***
EA	-.234 (.157)	-.264 (.163)	.027 (.178)
TA	.556 (.187)**	.557 (.188)**	.417 (.202)*
Village size (Small)		-.166 (.280)	-.240 (.288)
Age (65-80)			
18-25			.744 (.627)
25-40			-.105 (.629)
40-65			-.591 (.598)
Gender (Male)			.224 (.288)
Model significance	.000	.000	.000
Nagelkerke Pseudo R-square	.393	.393	.440

Table 11: Ordinal regression model estimation results for ITS (N=204).
*Note: Standard errors are reported in brackets. *p<.05, **p<.01, ***p<.001.*

A multivariate ordinal logistic regression was conducted with the outcome variable being intention to share (ITS). The age groups 0-18 and 80> are excluded from the regression because of missing correlations, both groups have too little respondents.

Regarding model 1 (table 11), it was found that for an increase of 1 in perceived benefits (PB) an increase of 1.872 (p<.001) in the ordered log odds of being in higher level of intention to share is expected, given all of the other variables are held constant. A statistical significant result was also found for technological attitude (TA); for increasing TA an increase of .556 (p<.01) in the ordered log odds of being in higher level of intention to share is expected, given all of the other variables are held constant. Perceived accessibility (-.178) and environmental attitude (EA) (-.234) are negatively associated with ITS. However both of these variables have statistically insignificant contribution to the model. The perceived accessibility and attitudinal factors explain 39,3 percent of the total variance in the data (Nagelkerke R-Square).

In model 2 (table 11) the contextual variable village size was added. It was found that controlling for the other variables and compared to big remote village, living in a small remote village a .166 decrease in the ordered log odds of being in a higher level of intention to share is expected. However, the variable village size was not tested significant. Adding village size, resulted in a small increasing ordered log odds for perceived benefits and technological attitude on sharing intention. The Nagelkerke R-square however did not change compared to model 1.

Model 3 (table 11) also considered the socio-demographic variables age and gender. The reference category was 65-80. So given all other variables are constant, for age group 18-25 the ordered log odds of being in higher level of intention to share is .744 more likely. For the age group 25-40, compared to 65-80 a decrease (-.105) in the ordered log odds of being in a higher level of intention to share is expected. Lastly for the age group 40-65 the ordered log odds of being in a higher level of intention to share decreases with .591. All age categories however are tested insignificant. With regards to gender, which also showed insignificant results, for male the ordered log odds of being in a higher level of intention to share is .224 more likely compared to female. By adding socio-demographic variables age and gender to the model, the model fit increased to 44 percent.

5. Discussion

This section provides a discussion of the results and an interpretation of the main findings.

By using the PAC-index of Lättman et al. (2016), the results overall show that respondents of rural villages in Drenthe perceive high accessibility. This supports earlier research, finding that although rural areas have low spatial accessibility differences in perceived accessibility between urban and rural areas are minimal (Pot et al., 2023). In addition there is no significant difference in perceived accessibility between residents of small remote villages and big remote villages. For individuals with public transport or walking as main mode of transport, perceived accessibility is lower compared to other modes of transport. The survey results also show that dissatisfaction with current transportation mode is occurs more frequently amongst public transport users. These findings suggest that when relying on public transport in rural areas in Drenthe, individuals experience low accessibility and will be more likely to be dissatisfied with this transportation mode possibly because of the deteriorating bus services and connections in these areas. This could also reflect the possibility that people who have their drivers' license, but do not own a car, would be using car-sharing to bridge the gap between their travel expectations and their experienced public transport usage.

With regards to car-sharing, the majority of respondents find car-sharing a good and flexible alternative to owning a car. Most respondents also think car-sharing could reduce environmental pollution, car ownership and spending on transport. Moreover they think sharing a car would be most suitable for non-work trips. However, car-sharing is mostly not seen as a safe and fast option. In addition, the results show that respondents are not confident that people will handle car-sharing the right way. The overall interest in car-sharing if it would be available in or nearby rural village residency is relatively low. As also found by Wappelhorst et al. (2014), the adoption of new mobility services in rural areas is countered by a high car affinity and strong car dependency amongst rural dwellers. Car dependency in these areas as a result of deteriorating public transport services might be increasing. Respondents that are intended to use car-sharing would do so in 2-5 years if it is available in less than 10 minutes walking or cycling distance. Additionally, even though P2P sharing is the most common system in rural areas and Drenthe (Meelen et al., 2019), results show that the majority of respondents would be most interested in station-based or free-floating B2C car-sharing. The main reason for potential car-sharing users to adopt a sharing system is the absence of a private car or an insufficient amount of cars in the household.

It was considered that lower levels of perceived accessibility could result in higher levels of sharing intention. However, no significant association between perceived accessibility and intention to share was found. Another contradicting result to the conceptual model is that travel mode and satisfaction are not related to one's intention share. The results of the analysis further reveal that, in line with previous research, peoples intention to make use of car-sharing can be derived from a persons attitudes towards the concept (Acheampong & Siiba, 2019). It was found that the perceived benefits, so the level of positive perceptions about the likely benefits of car-sharing, and the technological attitude towards car-sharing are positively associated with the intended use. However the role of a positive environmental attitude in predicting ones sharing intention was not found statistically significant. This contradicts earlier research finding that the environmental friendliness of an individual determines adoption intention (Machado et al., 2018; Münzel et al.,2019). This opposing results can be explained by the smaller sample size of this research. Another explanation can be the relative high proportion of lower-educated respondents, because as found by Curtale & Liao (2021) higher educated people appear to have a more positive environmental attitude. However considering the relatively high calculated mean of environmental attitude, education is not likely to play a role.

This research furthermore found that size of village residency, being either small remote or big remote, is not significantly associated with one's car-sharing intention. Whereas several previously conducted studies discovered that car-sharing users, and potential users, are more likely to be male and aged approximately below 35 (Seik, 2000; Zhou, 2012; Arcidiacono & Pais, 2018), the results of this study indicate that the socio-demographic factors age and gender are not directly associated with intended car-sharing usage. However, in the context of this study, this has to be interpreted carefully because, as the results of the survey have shown, the majority of respondents have an age between 40 and 65. On the other hand, in the Netherlands, Münzel et al., (2019), did also not found significant influence of gender on car-sharing adoption intention. This contradicting results can also be due to the difference in sample size or sample representativeness which is further discussed in chapter 7.

6. Conclusion & policy recommendations

This thesis aimed to explore shared mobility options, in particular car-sharing, in rural areas which could possibly contribute to the accessibility of rural dwellers. The underlying objective was to get insight into the determining factors in citizens' shared mobility adoption intentions. By a quantitative, multiple case study design, the research question; How do perceived accessibility and attitudes towards sharing affect car-sharing as a mobility solution for rural areas in Drenthe, was explored. This chapter provides an answer to the main research question by addressing the four sub-questions that stood central in this research.

In the Netherlands the availability of shared mobility has grown over the last couple of years. However currently the availability of shared cars in the Netherlands is primarily concentrated in highly urbanized areas. The large majority of car-sharing supply comes from C2C systems, which includes P2P platforms and local community sharing. B2C sharing, either station-based or free-floating, make up a smaller share of the market. Ridesharing and On Demand Ride Services are currently not, to scarcely, occurring in the Netherlands. In Drenthe there is a very limited supply of shared cars. Only in the capital city Assen Greenwheels provides several cars. Moreover since recently a pilot with shared cars runs in several rural villages in Drenthe. Generally it is difficult for B2C providers to profit from shared cars in low density regions. Therefore P2P sharing is more widely adopted in rural areas, also in Drenthe.

Despite the low calculated accessibility in rural areas in the Netherlands, experienced accessibility is not that low. In fact, perceived accessibility amongst inhabitants of remote villages in Drenthe is relatively high, especially amongst car users. However, rural inhabitants with public transport or walking as their main mode of transport experience lower accessibility. Overall rural residents are satisfied with their current travel mode, only public transport users are more frequently dissatisfied.

Potential car-sharing adopters in rural areas in Drenthe are individuals with a high level of positive perceptions about the likely benefits of car-sharing and a positive technological attitude. In theory, but not supported by this research, environmental attitude, age and educational attainment are other determinants for sharing adoption intention. Inhabitants of rural villages in Drenthe that are intended to use car-sharing if it would be available would do so in 2-5 years and if it is available in less than 10 minutes walking or cycling distance from their residence. Additionally, the most interest is in station-based or free-floating B2C car-sharing. The main reason for potential car-sharing users to adopt a sharing system is the absence of a private car or an insufficient amount of cars in the household.

The perceived accessibility of rural residents in Drenthe is not dependent on the size of village residency. Residents of small remote villages and big remote villages experience no significant different level of accessibility, evidently because of 'residential self-selection'. For sharing intention village size as well did not play a role. So personal, attitudinal factors are more predictable in ones intention to share then context and socio-demographic variables.

All in all, it can be concluded that because of the relative high perceived benefits, environmental attitude and technological attitude there is potential for car-sharing to contribute to the accessibility of residents in rural areas in Drenthe. Despite the lack of evidence regarding the relationship between perceived accessibility and sharing intention, individuals relying on public transport or without car ownership could positively benefit from car-sharing. Because it offers flexibility and option values to the current transport system. Car-sharing would be most successful by providing B2C car-sharing systems, at hubs with the possibility of multi-modal transport, including additional facilities possibly in combination with MaaS. However, the current interest in car-sharing is likely to be too low for businesses to make a profit. Partly due to high levels of car ownership and thus high levels of perceived accessibility.

So if the Netherlands wants to aim for a future sustainable and social inclusive transportation system, guiding policies are needed, especially in rural areas. Because economic feasibility of sharing systems in rural areas is questionable, public actors should support the implementation of car-sharing by emphasizing its environmental and social goal. To increase the potential user base, investments in campaigns and pilot projects could be made. Because previous personal experience or positive experience of one's social network with car-sharing increases sharing intention. Moreover, by performing pilots and researching their business models, uncertainties regarding costs and adoption intention could be decreased. Furthermore investment in hubs can play a facilitating role in further developing a shared mobility system. To decrease the high car dependency in rural areas, investments into car accessibility should be kept to a minimum. In fact, walking, cycling and public transport should receive the most attention to increase sustainable multi-modal trips. In order to prevent sharing systems from replacing public transport, car-sharing should be integrated in and accompanied by an efficient and affordable public transport system.

7. Reflection & future research

Since the sample size of this research (N=204) was relatively small in contrast to other comparable research, there is some uncertainty involved with regards to generalising the findings. This research provided a fraction of the perceived accessibility and sharing intention of rural residents in 6 remote villages in Drenthe. However, this study did not generate as many significant results compared to other research on this topic. The distortion in the results can be the consequence of a small sample size or a possible non-representative sample due to the chosen sampling strategy. For example the age group 65-80 comprised a relative small proportion of the sample. In addition, individuals without the technological skills to fill in an online survey are not represented in the sample. Increased sample size could have given a better insight in the influencing factors in car-sharing for rural residents and the potential relationship between car-sharing and accessibility. Moreover, it would increase the generalisability for other rural areas in Drenthe. However, as mentioned earlier, accessibility is dependent on land-use and transport and therefore location specific. Therefore generalisation of findings in this context is even more complex.

With regards to the question about preferred car-sharing systems (either station-based, free-floating or P2P), instead of choosing between the three, it would have been better to let respondents indicate for each system how likely they would be to use this system. This way, deeper insights into the different intended used systems would have been generated because individuals might want to use one particular system rather than the other.

Despite the late start of this research process, there were limited experienced difficulties during this research process. The data was collected on time and for most villages it was easy to approach respondents. Because the researcher did not have much social connections in Fluitenberg, Klazienaveen and Nieuw-Amsterdam, data collection was more difficult. However after all multiple visits to the villages increased the response rate. A limitation of this research was the lack of statistical skills of the researcher. Previous experience with statistical tests and particularly SPSS had been faded over the last years. So advanced statistical skills could have made this research process go more smooth and results could have been analysed more extensively. In hindsight follow-up interviews with public actors, private actors for example car-sharing companies and rural residents of Drenthe could have clarified the reasons behind the results. But unfortunately time was limited.

Because of the high car dependency, and overall satisfaction with that mode, future research into this topic could further explore the role of car dependency on the car-sharing adoption intention of rural dwellers. Other interesting future research directions are in car-sharing business models to explore the economic feasibility of implementing a shared mobility system in areas with low population density. Moreover, since this research found that the general intention to make use of car-sharing if it would be available is low, follow up studies could examine what successful strategies are for increasing the potential user base. Specifically in rural areas with high car dependency.

References

Acheampong, R. A., & Siiba, A. (2019). Modelling the determinants of car-sharing adoption intentions among young adults: the role of attitude, perceived benefits, travel expectations and socio-demographic factors. *Transportation*, 47(5), 2557–2580.

Adjei, P. O., Kosoe, E. A., & Forkuor, D. (2016). Facts Behind the Myth of Conservative Rurality: Major Determinants of Rural Farmers' Innovation adoption Decisions for Sustainable agriculture. *GeoJournal*, 82(5), 1051–1066.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.

Amaral, A. M., Barreto, L., Baltazar, S., Silva, J. P., Goncalves, L. (2020). *Implications of Mobility as a Service (MaaS) in Urban & Rural Environments: Emerging research and Opportunities*. IGI Global: United States of America.

Arcidiacono, D., & Pais, I. (2018). Think mobility over: A survey on Car2Go users in Milan. *In Research for development.*

Arias-Molinares, D., & Palomares, J. C. G. (2020). The WS of MAAS: Understanding Mobility as a Service fromAliterature Review. *Iatss Research*, 44(3), 253–263.

Bastiaanssen, J., Breedijk, M. (2022). *Toegang voor iedereen? Een analyse van de (on)bereikbaarheid van voorzieningen en banen in Nederland*. Den Haag: Planbureau voor de Leefomgeving.

Becker, H., & Ciari, F. (2017). Comparing car-sharing schemes in Switzerland: user groups and usage patterns. *Transportation Research Part A-policy and Practice*, 97, 17–29.

Becker, H., Ciari, F., Axhausen, K.W. (2017). Comparing car-sharing schemes in Switzerland: user groups and usage patterns. *Transportation Research A Policy Practice*, 97, 17–29

Bell, D. (2019). Intermodal Mobility Hubs and User Needs. *Social Sciences*, 8(2), 65.

Blad, K., De Almeida Correia, G. H., Van Nes, R., & Annema, J. A. (2022). A methodology to determine suitable locations for regional shared mobility hubs. *Case studies on transport policy*, 10(3), 1904–1916.

Botsman, R., Rogers, R. (2010). *What's Mine is Yours: The Rise of Collaborative Consumption*. Harper Business, New York.

Briceno, T., Peters, G. P., Solli, C., & Hertwich, E. G. (2005). Using Life Cycle Approaches To Evaluate Sustainable Consumption Programs: Car-sharing. *Norwegian University of Science and Technology Industrial Ecology Programme, Trondheim, Norway.*

Brovarone, E. V., & Cotella, G. (2020). Improving Rural Accessibility: a multilayer approach. Sustainability, 12(7), 2876.

Bullock, C., Scott, M., & Gkartzios, M. (2011). Rural Residential Preferences for house Design and Location: Insights from a Discrete Choice Experiment applied to Ireland. *Journal of Environmental Planning and Management*, 54(5), 685–706.

Cao, X.J., Mokhtarian, P.L. & Handy, S.L. (2009). Examining the Impacts of Residential SelfSelection on Travel Behaviour: A Focus on Empirical Findings. *Transport Reviews*, 29(3), 359-395.

Castellanos, S., Grant-Muller, S., & Wright, K. (2021). Technology, Transport, and the Sharing Economy: Towards a working taxonomy for shared Mobility. *Transport Reviews*, 42(3), 318–336.

Chen, X., Zahiri, M., Zhang, S. (2017). Understanding ridesplitting behavior of on-demand ride services: An ensemble learning approach. *Transportation Research Part C Emergence Technology*, 76, 51–70.

Clayton, S. D. (2012). *The Oxford Handbook of Environmental and Conservation Psychology.* Edited, in the Oxford University Press.

Coenegrachts, E., Beckers, J., Vanelslander, T., & Verhetsel, A. (2021). Business model blueprints for the Shared Mobility Hub Network. *Sustainability*, 13(12), 6939.

Cohen, A., Shaheen, S. (2018). *Planning for Shared Mobility*. American Planning Association: Washington.

Creswell, J.W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th edition. Los Angeles: Sage.

Curtale, R., & Liao, F. (2021). User acceptance of electric car-sharing services: the case of the Netherlands. *Transportation Research Part A-policy and Practice*, 149, 266–282.

Dasgupta, P., J.F. Morton, D. Dodman, B. Karapinar, F. Meza, M.G. Rivera-Ferre, A. Toure Sarr, and K.E. Vincent. (2014). *Rural areas*. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 613-657

De Jong, W. K., Vogels, J., Van Wijk, K., & Cazemier, O. (2011). The key factors for providing successful public transport in low-density areas in the Netherlands. *Research in transportation business and management*, 2, 65–73.

De Luca, S., & Di Pace, R. (2015). Modelling users' behaviour in Inter-urban carsharing Program: A Stated Preference approach. *Transportation Research Part A-policy and Practice*, 71, 59–76.

Delbosc, A., & Currie, G. (2018). Accessibility and exclusion related to well being. *In Applying quality of life research* (pp. 57–69). *Springer International Publishing*.

Dias, F. A., Lavieri, P. S., Garikapati, V. M., Astroza, S., Pendyala, R. M., & Bhat, C. R. (2017). A behavioral choice model of the use of car-sharing and ride-sourcing services. *Transportation*, 44(6), 1307–1323.

Dugundji, E. R., Páez, A., Arentze, T. T., Walker, J. L., Carrasco, J. M. C., Marchal, F., & Nakanishi, H. (2011). Transportation and social interactions. *Transportation Research Part A-policy and Practice*, 45(4), 239–247.

Eckhardt, J., Lauhkonen, A., & Aapaoja, A. (2020). Impact Assessment of Rural PPP MAAS pilots. *European Transport Research Review*, 12(1).

Erhardt, G. D., Roy, S., Cooper, D., Sana, B., Chen, M., & Castiglione, J. (2019). Do transportation network companies decrease or increase congestion? *Science Advances*, 5(5).

Farrington, J. W., & Farrington, C. (2005). Rural Accessibility, Social Inclusion and Social Justice: towards Conceptualisation. *Journal of Transport Geography*, 13(1), 1–12.

Fleury, S., Tom, A., Jamet, E., & Colas-Maheux, E. (2017). What drives corporate carsharing acceptance? A French case study. *Transportation Research Part F-traffic Psychology and Behaviour*, 45, 218–227.

Frank, L. D., Dirks, N., & Walther, G. (2021). Improving rural accessibility by locating multimodal mobility hubs. *Journal of Transport Geography*, 94, 103111.

Frank, L., Dirks, N., & Walther, G. (2021). Improving rural accessibility by locating multimodal mobility hubs. *Journal of Transport Geography*, 94, 103111.

Furuhata, M., Dessouky, M., Ordóñez, F., Brunet, M., Wang, X., & Koenig, S. (2013). Ridesharing: the state-of-the-art and future directions. *Transportation Research Part B-methodological*, 57, 28–46.

Gebre, T., & Gebremedhin, B. (2019). The mutual benefits of promoting rural-urban interdependence through linked ecosystem services. *Global Ecology and Conservation*, 20, e00707.

Gedeputeerde staten van Drenthe. (2020, 22 December). *Mobiliteitsprogramma 2021-2030.* Provinciale staten van Drenthe.

Geurs, K. T., & Van Wee, B. (2004). Accessibility Evaluation of land-use and transport Strategies: Review and research directions. *Journal of Transport Geography*, 12(2), 127–140.

Greenwheels. (2023). Official website, retrieved on 02-07-2023, from: https://www.greenwheels.nl/?utm_source=google&utm_medium=cpc&utm_campaign=nl|brand|mobile&network=g&device=c&gad=1&gclid=CjwKCAjwq4imBhBQEiwA9Nx1BmXax4ZZtxF_oM0Td20hYiVt-SFOxXnUSmhScu1tFVApPq72FEqZcRoCIv0QAvD_BwE

Hamers, D., D. Snellen, M. Breedijk, H. Hilbers, K. Nabielek & J. Tennekes (2014). *Kiezen én delen: Strategieën voor een betere afstemming tussen verstedelijking en infrastructuur*. Den Haag: Planbureau voor de Leefomgeving (PBL)

Het Parool. (2022, 29 June). Honderden lokale politici sturen brandbrief over ov: 'Verder bezuinigen is geen optie'. https://www.parool.nl/amsterdam/honderden-lokale-politici-sturen-brandbrief-over-ov-verder-bezuinigen-is-geen-optie~b1375076/

Hine, J. and Mitchell, F. (2016) *Transport disadvantage and social exclusion : exclusionary mechanisms in transport in urban scotland*. London: Routledge (Transport and society).

Hult, Å., Perjo, L., & Smith, G. (2021). Shared mobility in rural contexts: Organizational insights from five Mobility-as-a-Service pilots in Sweden. *Sustainability*, 13(18), 10134.

Hunziker, S., & Blankenagel, M. (2021). *Research design in business and management: A Practical Guide for Students and Researchers*. Springer Gabler.

International Transport Forum. (2017). *Transition to Shared Mobility; how large cities can deliver inclusive transport services*. Corporate Partnership Board Report.

Jiao, J., & Wang, F. (2020). Shared mobility and transit-dependent population: a new equity opportunity or issue? *International Journal of Sustainable Transportation*, 15(4), 294–305.

Jin, S. T., Kong, H., Wu, R., & Sui, D. Z. (2018). Ridesourcing, the sharing economy, and the future of cities. *Cities*, 76, 96–104.

Jittrapirom, P., Caiati, V., Feneri, A., Ebrahimigharehbaghi, S., González, M. A., & Narayan, J. (2017). Mobility as a Service: A critical review of definitions, assessments of schemes, and key challenges. *Urban planning*, 2(2), 13–25.

Jones, S.R. (1981). Accessibility measures: A literature review. *Transport and Road Research Laboratory*.

Jorritsma, P., Witte, J-J., Alonso-González, M., Hamersma, M. (2021). *Deelauto- en deelfietsmobiliteit in Nederland: Ontwikkelingen, effecten en potentie*. KiM Netherlands Institute for Transport Policy Analysis.

Kennisinstituut voor Mobiliteitsbeleid (KiM). (2021, October). *Deelauto- en deelfietsmobiliteit in Nederland.* Ministerie van Infrastructuur en Waterstaat, Den Haag

Kennisinstituut voor Mobiliteitsbeleid (KiM). (2023, 3 April). *Bereikbaarheid stad en platteland verschillen, maar beleving is hetzelfde*. Ministerie van Infrastructuur & Waterstaat, Den Haag. Retrieved from: https://www.kimnet.nl/actueel/nieuws/2023/04/03/bereikbaarheid-stad-en-platteland-verschillen-maar-beleving-is-hetzelfde

Laporte, G., Meunier, F., & Calvo, R. W. (2015). Shared mobility systems. *4 Operations Research*, 13(4), 341–360.

Lättman, K., Friman, M., & Olsson, L. E. (2016). Perceived accessibility of public transport as a potential indicator of social inclusion. *Social Inclusion*, 4(3), 36–45.

Lättman, K., Friman, M., & Olsson, L. E. (2016). Perceived accessibility of public transport as a potential indicator of social inclusion. *Social Inclusion*, 4(3), 36–45.

Lättman, K., Olsson, L. E., & Friman, M. (2018). A new approach to accessibility – examining perceived accessibility in contrast to objectively measured accessibility in daily travel. *Research in Transportation Economics*, 69, 501–511. https://doi.org/10.1016/j.retrec.2018.06.002

Li, W., & Kamargianni, M. (2019). Steering Short-term Demand for car-sharing: A mode choice and Policy Impact Analysis by trip distance. *Transportation*, 47(5), 2233–2265.

Li, Y., Westlund, H., & Liu, Y. (2019). Why some rural areas decline while some others not: An overview of rural evolution in the world. *Journal of Rural Studies*, 68, 135–143.

Machado, C. A. S., De Salles Hue, N. P. M., Berssaneti, F. T., & Quintanilha, J. A. (2018). An overview of shared mobility. *Sustainability*, 10(12), 4342.

Meelen, T., Frenken, K., & Hobrink, S. (2019). Weak spots for car-sharing in the Netherlands? The geography of socio-technical regimes and the adoption of niche innovations. *Energy research and social science*, 52, 132–143.

Metz, D. C. (2012). Demographic determinants of daily travel demand. *Transport Policy*, 21, 20–25.

Ministerie van Infrastructuur en Waterstaat. (2021). *Ontwikkelagenda Toekomstbeeld OV. Nu instappen naar 2040*. Den Haag, January 2021.

Ministry of Infrastructure and Water Management. (2019). MaaS Pilot Projects. Optimizing Mobility. The Hague.

Moseley, M.J. (1979). *Accessibility: The Rural Challenge*. Methuen: London, UK.

Mounce, R., Beecroft, M., & Nelson, J. D. (2020). On the role of frameworks and smart mobility in addressing the rural mobility problem. *Research in Transportation Economics*, 83, 100956.

Mourad, A., Puchinger, J., & Chu, C. (2019). A survey of models and algorithms for optimizing shared mobility. *Transport Research Part B: Methodological*, 123, 323–346.

Mulley, C., Nelson, J. D., Ho, C. Q., & Hensher, D. A. (2023). MaaS in a regional and rural setting: Recent experience. *Transport Policy*, 133, 75–85.

NOS. (2023, 25 February). Ruim 1500 bushaltes minder dan in 2018, impact verschilt lokaal sterk. *NOS*. https://nos.nl/collectie/13923/artikel/2465241-ruim-1500-bushaltes-minder-dan-in-2018-impact-verschilt-lokaal-sterk

Paiva, S., Ahad, M. A., Tripathi, G., Feroz, N., & Casalino, G. (2021). Enabling Technologies for urban smart mobility: recent trends, opportunities and challenges. *Sensors*, 21(6), 2143.

Porru, S., Misso, F. E., Pani, F. E., & Repetto, C. (2020). Smart mobility and public transport: opportunities and challenges in rural and urban areas. *Journal of Traffic and Transportation Engineering*, 7(1), 88–97.

Pot, F. J., Koster, S., & Tillema, T. (2023). Perceived accessibility and residential self-selection in the Netherlands. *Journal of Transport Geography*, 108, 103555.

Pot, F. J., Van Wee, B., & Tillema, T. (2021). Perceived accessibility: What it is and why it differs from calculated accessibility measures based on spatial data. *Journal of Transport Geography*, 94, 103090.

Prieto, M., Baltas, G., & Stan, V. (2017). Car sharing adoption intention in urban areas: What are the key sociodemographic drivers? *Transportation Research Part A-policy and Practice*, 101, 218–227.

Provincie Drenthe. (2022, June). Proef elektrische deelauto's in provincie Drenthe en Groningen na de zomer van start. Retrieved from: https://www.provincie.drenthe.nl/actueel/nieuwsberichten/2022/juni/proef-elektrische-deelauto-provincie/

Qiu, L., & He, L. (2018). Bike sharing and the Economy, the Environment, and Health-Related Externalities. *Sustainability*, 10(4), 1145.

Reisviahub. 2023. Groningen en Drenthe eenvoudig bereikbaar via hubs. Retieved on 26-06-2023, from: https://www.reisviahub.nl/groningen-en-drenthe-eenvoudig-bereikbaar-via-hubs/

Rongen, T., Tillema, T., Arts, J., Alonso-González, M. J., & Witte, J. (2022). An analysis of the mobility hub concept in the Netherlands: Historical lessons for its implementation. *Journal of Transport Geography*, 104, 103419.

Roukouni, A., & Van Arem, B. (2020). Evaluation Methods for the Impacts of Shared Mobility: Classification and Critical Review. *Sustainability*, 12(24), 10504.

Scottisch Government. (2018, 29 March). *Scottish Government Urban Rural Classification 2016.* Advise and guidance.

Seik, F. T. (2000). Vehicle ownership restraints and car sharing in Singapore. *Habitat international*, 24(1), 75–90.

Shaheen, S., Cohen, A. (2018). Impacts of shared mobility. *Institute of Transportation Studies*, *2018* (02).

Shaheen, S., Cohen, A., Zohdy, I. (2016). *Shared Mobility: Current Practices and Guiding Principles; U.S.* Department of Transportation, Federal Highway Administration: Washington, DC, USA, 120p.

Silva, C. (2013). Structural accessibility for mobility management. *Progress in Planning*, 81, 1–49.

Simon et al (2007) Simon, C., L. Vermeij en A. Steenbekkers (2007). *Het beste van twee werelden. Plattelanders over hun leven op het platteland*. Den Haag: Sociaal en Cultureel Planbureau.

Smith, G., & Hensher, D. A. (2020). Towards a framework for Mobility-as-a-Service policies. *Transport Policy*, 89, 54–65.

Social Exclusion Unit. (2003, February). *Making the connections: Final Report on Transport and Social Exclusion*. London: Social Exclusion Unit.

Sprei, F., Habibi, S., Englund, C., Pettersson, S., Voronov, A., & Wedlin, J. (2019). Free-floating car-sharing electrification and mode displacement: travel time and usage patterns from 12 cities in Europe and the United States. *Transportation Research Part D-transport and Environment*, 71, 127–140.

Stanley, J., & Lucas, K. (2008). Social exclusion: What can public transport offer? Research in *Transportation Economics*, 22(1), 36–40.

Sun, F., Chen, P., & Jiao, J. (2018). Promoting public bike-sharing: A lesson from the unsuccessful Pronto system. *Transportation Research Part D-transport and Environment*, 63, 533–547.

U.S. Department of Transportation. (2021, November). *History Of intelligent Transport Sytems, 2021* Update.

Velaga, N. R., Nelson, J. D., Wright, S. J., & Farrington, J. W. (2012). The Potential Role of Flexible Transport Services in Enhancing Rural Public Transport Provision. *Journal of Public Transportation*, 15(1), 111–131.

Velaga, N. R., Nelson, J. D., Wright, S. J., & Farrington, J. W. (2012b). The Potential Role of Flexible Transport Services in Enhancing Rural Public Transport Provision. *Journal of Public Transportation*, 15(1), 111–131.

Vinkenvleugel, S. (2022, 7 September). Minder buslijnen door bezuinigingen, maar geen stijging van het tarief. *RTV Drenthe*. https://www.rtvdrenthe.nl/nieuws/14945954/minder-buslijnen-door-bezuinigingen-maar-geen-stijging-van-het-tarief

Wappelhorst, S., Sauer, M., Hinkeldein, D., Bocherding, A., & Glaß, T. (2014). Potential of electric carsharing in urban and rural areas. *Transportation research procedia*, 4, 374–386.

Wegner, M., & Fürst, F. (1999). Land-use transport interaction: State of the art. Deliverable 2a of the European Project TRANSLAND.

Witte, J., Alonso González, M., Rongen, T. (2021). Verkenning van het concept mobiliteitshub. Kennisinstituut voor het Mobiliteitsbeleid, Den Haag, May 2021.

Zhou, J. (2012). An analysis of university employee car-sharers in Los Angeles. *Transportation Research Part D-transport and Environment*, 17(8), 588–591.

Appendix 1: Questionnaire design

Block 1: Socio-demographic items	**Response format**
Age	Age in years
Gender	Male / Female / Other / Prefer not to answer
Highest educational attainment	No schooling completed / High school graduate / MBO graduate / HBO graduate / WO graduate
Employment	Employed / Unemployed / Student / Retired / ZZP'er / Prefer not to answer
Household size (including respondent)	1 / 2 / 3 / 4 / 5 or more
Car ownership in household	1 /2 / 3 cars or more / no cars
Place of residence	Village name
Driver's license	Yes / no

Block 2: Current travel mode	**Response format**
Main mode of travel work/school/other	Car / Public transport / Bicycle / Walking / Other
Satisfaction with travel mode	Satisfied / Not satisfied
Travel time to work/school/other	<30 min / 30 min-1 hr / 1-2 hr / >2 hr
Knowledge of (car) sharing	No knowledge / Some knowledge / A lot of knowledge

Block 3: Perceived accessibility items	**Response format** 7-Point Likert Scale: 1=Completely disagree – 7=Completely agree
Considering how I travel today it is easy to do my daily activities	
Considering how I travel today I am able to live my life as I want to	
Considering how I travel today I am able to do all activities I prefer	
Access to my preferred activities is satisfying considering how I travel today	

Block 4: Perceived benefits	**Response format** 5-point Likert scale: 1= Strongly disagree – 5= Strongly agree
Good alternative to owning a car	
Could reduce environmental pollution	
Sharing would be safe	
Sharing would be the fastest option to travel	
Sharing would be flexible	
Sharing would reduce the need for a personal vehicle	
Sharing could reduce spending on transport	
Sharing would be suitable for work trips	

Sharing would be suitable for non-work trips	

Block 5: Environmental attitude	**Response format** 5-point Likert scale: 1= Strongly disagree – 5= Strongly agree
I am concerned about the environmental destruction and climate change	
I am willing to spend a bit more to buy product or use a service that is more environmentally friendly	
I would change my behaviour based on concern for the environment	

Block 6: Technological attitude	**Response format** 5-point Likert scale: 1= Strongly disagree – 5= Strongly agree
I think technology is generally a good thing	
I am excited about the possibilities offered by new technologies in solving societal challenges	

Block 7: Other	**Response format** 5-point Likert scale: 1= Strongly disagree – 5= Strongly agree
I can trust car-sharing with other people/stangers and have good stewardship standards	
I think car-sharing is innovative transport solution	

Block 8: Intention to share	**Response format**
Would you be interested in shared mobility (if available in your village/nearby village)	5-point scale: 1= Definitely not – 5= Absolutely yes
What time a day would you use this service?	Daytime (06.00-18.00) / Night-time (18.00-06.00)
When would you use this service?	Within the coming year / Within the first 2-5 years / 5 years or longer
What system would you be using?	B2C (station-based) / B2C (free-floating) / C2C (peer2peer)
What would be the maximum walking/cycling distance to the service for you to use it?	<5 min / <10 min / <15 min / <20 min / <25min
What would be the main reason for using the service?	Shortening travel time / Sustainability / Enjoyment / No vehicle ownership / Different