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School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

The Opportunities Given by Waterway Connections During Highway Reconstruction

Jelmer van Herpen

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences

SUPERVISOR :

Prof. dr. Elke HERMANS

MENTOR :

Mevrouw Veerle COPS



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Preface

Before you lies the Master Thesis ‘The opportunities given by waterway connections during highway construction’. The Master Thesis is the final part of the Master of Transportation Sciences by distance learning at the University of Hasselt and the conclusion of my time as a student. The Master Thesis research was conducted between January and June 2023. The thesis is presented by means of this Master Thesis report and an oral defence. By the end of June 2023 I hope to receive the final grades and receive confirmation that I have successfully reached the end of the study programme.

Because of the conditions of this Master of Transportation Sciences, I had to be employed to participate in this study programme. The combination between my work at the consultancy of XTNT and my study at the University of Hasselt was very interesting for this thesis, because of the benefits that could be served for both at the same time. As the university submitted a list of possible subjects for the thesis, it was up to me to determine how I could combine an academic Master Thesis with a subject that would be useful for XTNT. Moreover, the subject would also have to be something that would really excite me and challenge me over several months. Although travel over water is something quite common in the Netherlands, I always thought of it as somewhat a niche. In my years working for XTNT, I never encountered projects where travel over water was an integral part of the project and therefore never got the chance to dive deeper into this subject. With this thesis, that has changed for the better. Travel over water is a very specific and location-bound opportunity in many different places around the world and, of course, in the Netherlands. This master thesis broadened my view on travel over water and helped me understand how and by whom travel over water can be used to support our pressurized transportation system.

I would like to thank my university supervisors, Prof. dr. Elke Hermans and Veerle Cops, for their help and guidance during the master thesis. With only a limited number of contact moments, the feedback given was vital for the thesis progression. I would also like to thank my supervisors from XTNT, Ilse van Zijl and Birgitta Jansen. They did not only help with the process to come to this final product, but also helped connecting me to the project team of the A27 project for example. Furthermore, I would like to thank my colleagues at XTNT for their help during this master thesis. Not only for their help with their good ideas, sources or other content-related solutions, but also for their general interest in and curiosity about this thesis, which resulted in spontaneous moments and interesting conversations.

After three years of studying for a Bachelor in Breda and three years of parttime studying for a Master in Hasselt, I would also like to thank my family and friends for the advices, patience and motivational support during my time as a student.

Jelmer van Herpen
June 2023

Abstract

The growing amount of maintenance and construction operations on highways in the Netherlands asks for extensive mobility management measures to mitigate hindrance. The heavily pressurized road network in the Netherlands cannot cope with increasing amounts of traffic when (parts of) highways are closed and thus mobility management seeks for solutions in other modes of transportation. Many of the maintenance and construction operations concern bridges and tunnels on highways, which means cross-river traffic is heavily impacted. In terms of mobility management, transport over water might provide a solution for some target groups. However, it is currently still unknown how and by who transport over water might be used in these situations.

An example of a situation like this can be found around the Merwedeburg in the Netherlands, which will be reconstructed between 2023 and 2029. The bridge is one of the only fixed links in its region and has an important role for north-southbound traffic over the river Merwede. During its reconstruction, the capacity of the bridge will be limited and during some periods the bridge will even be closed completely. Rijkswaterstaat and Brabant Mobility Network (BMN) work together in an employers' approach to get the companies and municipalities in the region involved as the hindrance will impact them most. An interview with BMN and observations of conversations between BMN and employers showcased that travel over water was not used in mobility management yet.

Only limited academic literature is available on the possibilities to use travel over water as an alternative. Long-haul ferry operators have the most detailed information on passengers demand, but largely also rely on freight to make their ferries profitable. Important target groups divided on trip purpose include tourists, passengers visiting friends and family and passengers who travel for work. Local ferry services are also available throughout the world, albeit mostly in urban areas where network services are provided for (mostly) locals. The only division that was made in ferry passengers were divisions based of trip purpose. As far as academic literature goes, no sources were found which distinctively looked at travel over water as mode of transportation during a temporary (re)construction project.

Using a survey (n=402), the inhabitants of the Netherlands were asked about their attitudes and use patterns of ferries, as well as probabilities they would use the ferry for different trip purposes found in academic literature. When asked about their general attitude on travelling with a ferry, there were significant relations between gender and attitude (.005 with 95% confidence interval and 5% margin of error), as well as occupations and attitude (.026 with 95% confidence interval and 5% margin of error). The three target groups found to be most interesting for ferry usage are 1) employees and students for which the total trip is less than 15 kilometres, 2) passengers visiting family or friends and 3) recreational passengers. For the case study around the Merwedeburg, this means there is a total of around 2.500 potential passengers per day. In terms of communication, it would be vital to use geotargeting, local landmarks and the employers' approach by BMN to reach potential passengers. The ferry services should be frequent, reliable and available from early in the morning until late in the evening to provide a good enough service for potential passengers, for which travel time is an important motive. When these conditions are fulfilled, the ferry can provide a good alternative for traffic around the Merwedeburg and can be used as successful mobility management measure.

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List of Abbreviations

BC	British Columbia (Ferry Services Inc.)
BMN	Brabant Mobiliteitsnetwerk (Brabant Mobility Network)
CBA	Cost-Benefit Assessment
CBS	Centraal Bureau voor de Statistiek (Central Statistical Office)
FOD	Ferry-Oriented Development
GDPR	General Data Protection Regulation
IWT	Inland Water Transport
KiM	Kennisinstituut voor Mobiliteit
MaaS	Mobility as a Service
MRDH	Metropolitan Region Rotterdam The Hague
I&W	(Ministry of) Infrastructure and Water Management
ODiN	Onderweg in Nederland
P&O	Peninsular and Oriental Steam Navigation Company
RoPax	Passenger RoRo
RoRo	Roll-on roll-off
RWS	Rijkswaterstaat
SNDP	Service Network Design Problems
SP	Stated Preference
SSI	Semi Structured Interview
TOD	Transit-oriented development
VRA	Vervoerregio Amsterdam (Transport Authority Amsterdam)

1. Introduction

1.1 BACKGROUND AND RATIONALE

National and local governments in the Netherlands are facing the biggest maintenance operation in their histories, as the lifetime of many bridges, tunnels and other parts of infrastructure are coming to an end, whilst other parts of the road infrastructure suffer from increasing traffic intensity and insufficient traffic flow. A lot of the infrastructure in the Netherlands was built in the 1950's and 1960's, has been used intensively by traffic and has suffered under the increasing weight of that traffic as well. To keep the roads safe, Rijkswaterstaat has to repair, replace or maintain increasingly more parts of the infrastructure. Rijkswaterstaat forecasted that the total costs of this operation for the period between 2023 and 2030 would be approximately 4 billion euros. Forecasts for the decades after that were even higher, with a total cost of more than 14 billion euros in the period between 2041 and 2050 (Rijkswaterstaat, 2022a).

1.1.1 Maintenance preparation

Together with external companies, Rijkswaterstaat is already preparing several major maintenance operations at the moment. Of course, this includes cooperations with contractors responsible for the actual infrastructural maintenance. However, it also includes cooperations for a wider array of tasks, including agencies responsible for communication about the operation and agencies who aim at mitigating the hindrance which is the result of the maintenance operation. These agencies work for Rijkswaterstaat on the 'Minder Hinder' aspect of the operation, which can be translated to 'less hindrance' in English and is specifically aimed at mitigating hindrance caused by maintenance. Within Minder Hinder, three different solutions can be found to mitigate hindrance. These three aspects of mitigating hindrance are abbreviated to 'Slim Plannen, Slim Bouwen, Slim Reizen' (Rijkswaterstaat, 2022b):

- **Planning:** The mitigation of hindrance by using principles for planning and using adaptive planning of the maintenance operation.
- **Building:** The mitigation of hindrance by fulfilling the maintenance operation, in particular in terms of clever construction, in a way whilst still being able to work safely.
- **Travelling:** The mitigation of hindrance by using traffic management, mobility management and communication to influence mobility or travel behaviour and inform travellers about the circumstances.

Integrating these different aspects to mitigate hindrance might become harder over the next years. Whereas the years 2020 and 2021 were characterized by the Covid-19 pandemic (which resulted in decreasing traffic intensities), traffic in the years from 2022 onwards will surpass the pre-Covid intensities rapidly (Knoope, Faber & Francke, 2022). In 2022, traffic will already surpass pre-Covid intensities and due to a growth in population and a growth of the economy, the traffic intensities will keep on increasing towards 2027. Forecasting studies by Knoope and colleagues (2022) conducted for the KiM expect the number of kilometres driven by road traffic in the Netherlands to have increased by 7,4% in 2027 when compared to 2019 (Figure 1). That same study by Knoope and colleagues (2022) also acknowledge the structural effects of the Covid-19 pandemic, which

influenced the modal split and shifted around 3% of public transport travellers towards (mostly) other modes of transportation. These statistics create an image of increasing use of cars over the next years. With these statistics in mind, mobility management can be an important part of the Minder Hinder approach of RWS, as roads are getting fuller and the traffic intensities are increasing even further. Integrating mobility management is however deemed a location-specific measure in the approach of RWS. Anything that might work in a particular situation, might not be effective in another. Examples of this are measures to stimulate cycling in the summer in a region with a lot of local traffic, which might not be effective during other periods of the year when implemented in a region with a lot of long-haul traffic (Rijkswaterstaat, 2022b). However, using periods of hindrance as compelling events to establish changes is a promising way to influence the mobility in a region. Thinking and working from the perspective of the traveller is crucial to understand and influence their behaviour (Rijkswaterstaat, 2022b).

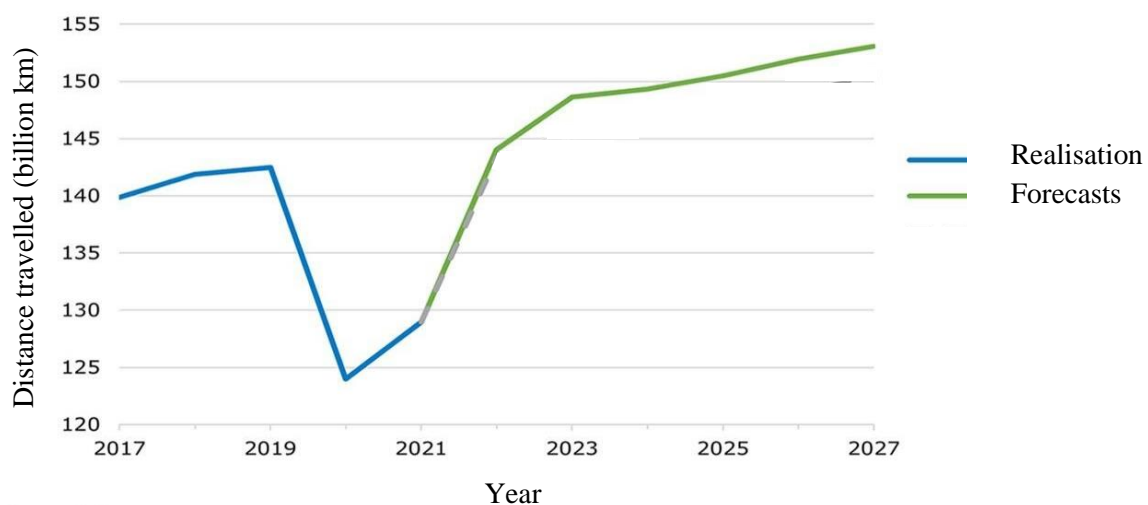


Figure 1 Total road traffic distance travelled within the Netherlands (KiM, 2022; adjusted)

1.1.2 Possibilities of mobility management

Mobility management can be divided into different parts. The Ministry of I&W acknowledges the importance of both preventing travellers from travelling on the main road network, as well as spreading travellers over different modes of transportation and spreading travellers over time throughout the day (Ministry of I&W, 2022). The role of the government consists of stimulating employers/employees and students to travel differently or not at all, which is further concretised in regional approaches.

Some of those regional approaches have already been given shape over the past decade. Since 2017, 'Groningen Bereikbaar' is available in the northern province of Groningen to keep the region accessible there, working together with at least 85 employers and several schools and universities on mobility management (Groningen Bereikbaar, 2020). In the province of Zuid-Holland (which includes cities like Rotterdam and the Hague), 'Zuid-Holland Bereikbaar' is working on keeping the region accessible with a multidisciplinary approach, which includes mobility management aimed at specific projects, but also mobility management on overarching regional level (Zuid-Holland Bereikbaar, 2021).

One of the oldest regional approaches exists in Brabant, where the ‘Brabant Mobility Network’ uses regional communities of (in total more than 550) employers to realise more sustainable travel in Brabant. On top of that, BMN also uses hindrance as compelling event to establish its communities and maximize the effect of its mobility management (BMN, 2023).

However, the effect of maintenance on the main road network cannot be underestimated. Even with ‘traditional’ mobility management measures, such as stimulation of cycling, the temporary closure or partial loss of capacity of bridges and tunnels spanning waterways leads to major accessibility problems. This was stressed by the Minister of I&W in his letter to the House of Representatives of The Netherlands in November 2022 (Harbers & Heijnen, 2022).

1.1.3 Travel over water as part of mobility management

When taking the combination between maintenance of bridges and tunnels with mobility management into consideration, there seems to be an element of mobility management missing. Standard mobility measures include cycling stimulation, but lack opportunities to support travel over water. An opportunity which seems to be adequate for the Netherlands as waterways dominate large parts of the country and influence the connections between regions, which can be seen in Figure 2. Rivers such as the Rhine, Meuse, Waal, including all of their branches, large bodies of waters such as the Oosterschelde, Westerschelde and many canals form natural barriers between regions. Temporarily closing or limiting the capacity of bridges and tunnels can be problematic, but the waterways can also provide new opportunities to travel differently.



Figure 2 Meuse and Rhine discharge into Netherlands (Klijn et al., 2018)

Although transport over water once played a major role for the connectivity within and between cities, land-based transit (trains, cars, public transport) has taken over as important modes of transport. Contemporary water transport has become scarce, also resulting in limited research on the subject. Research on CityCat ferries in Brisbane focused on the planning process of the CityCat concept, describing key actors and process steps in the establishment of a permanent ferry network (Tanko & Burke, 2015).

Other researchers looked at data to estimate origin-destination matrixes in New York (Rahman, Wong & Brakewood, 2017) or at the technology behind existing waterborne public transport systems (Cheemakurthy, Tanko & Garne, 2017). Research in Sweden looked mostly at the perception and planning factors of water transit, using the existing network then determining what factors increase satisfaction of travellers for example (Tanko, Cheemakurthy, Hall Kihl & Garne, 2019). These researches look at permanent networks, ranging from single lines to small city networks but always focused on fixed networks.

On the other hand, research on temporary networks is limited too. Of course, the theory of ‘user equilibrium’ can be used to assign travellers to a shortest individual path and the theory of ‘system optimal’ might help determine the best total travel time for the entire system (Jahn, Mörhing, Schulz & Stier-Moses, 2005). These theories of user equilibrium and system optimal can be applied to temporary situations as well, also by using road guidance systems (Jahn et al., 2005). Research into drivers’ behavioural response on these road guidance systems is plenty (Peeta & Jeong, 2006; Vreeswijk, Rahka, Van Berkum, Van Arem, 2015), but these studies focused on how drivers use alternative routes and were mostly based in the United States. What we do know is the traffic diversion models exist for temporary situations (for example during road closures) and can be based on alternative routes, traffic modelling and travellers’ choice behaviour (Memarian, Rosenberger, Mattingly, Williams & Hashemi, 2019). These researches do have a flaw considering a multimodal choice system: They either look at the choice of modality (for a system) or at the choice of route (for a single modality), but neither combines the two.

However, it is currently unknown how and by whom traffic over water can be used as successful alternative during these periods of hindrance when we consider a form of travel over water as a travel alternative within the transportation system. When these target groups can be determined, together with the conditions that have to be fulfilled by the mode of transportation used to travel over water, it will also be made possible to determine what impact travel over water can have on traffic and on mobility management. To gather useful information, a very broad study on the opportunities of travel over water can be considered. On the other hand, using a location-specific situation to further determine the possibilities for travel over water might provide more in-depth details and create better understanding.

1.1.4 Merwedebrug as a case study

With the amount of projects already ongoing, there are several possibilities to use a case study as part of the master thesis. One of those projects currently already in preparation is the expansion of the highway A27 between Houten and Hooipolder. Traffic jams are frequent on this road and a lack of alternative roads means calamities often result in regional problems. The expansion of the road is the only way to improve the situation (Rijkswaterstaat, 2022c). During the first months of 2023, Rijkswaterstaat is preparing the area around the A27 for reconstruction. For example, some of the cables besides the highway are relocated, thus making future construction areas ready for construction. At the end of 2023, construction will start on the Southern part of the A27, the node called Hooipolder. By 2026 Hooipolder will be finished, but the A27 itself will be reopened completely somewhere between 2029 and 2031. However, this highway crosses several rivers, such as the Lek, the Merwede and the Maas (Rijkswaterstaat, 2022c).

The expansion of the road means the old bridges will be replaced by new bridges able to cope with the increasing amount of traffic on this highway. Therefore, crossing the rivers using the A27 will be temporarily more difficult during the different phases of reconstruction, leading to extensive

traffic problems on the network. With a lack of alternatives and a body of water dividing the land, possibilities to cross the river during reconstruction of bridges are very limited. Regarding the literature mentioned in subparagraph 1.1.3, the case study at the A27 includes alternatives for both modes of transportation and routes, which makes it difficult to use a singular theory to determine possible solutions for the A27. On top of that travellers' choice behaviour at the A27 might differ from other case studies, as the transportation network and its users are different on the A27 compared to other (international) studies. To look at this case study in-depth can determine whether travel over water might be a solution that can help the project forwards as it might be another opportunity for some of the target groups that normally use the A27. And moreover, results from the case study at the A27 cannot only be used for the A27, but might also be used for future projects in other regions within the Netherlands.

1.1.5 Mobility management approach Merwedebrug

As mentioned in subparagraph 1.1.2 mobility management is seen by RWS as a location-specific solution and often takes place on overarching regional levels. One of the examples given was Brabant Mobiliteitsnetwerk, or BMN. BMN is a regional approach for the province of North Brabant and sets up networks of employers, educational institutions and governmental institutions in different regions. BMN then actively spreads new ideas or interventions to stimulate changes in mobility management. The networks created by BMN are seen as communities and are most often found around big cities or important highway links (BMN, 2023).

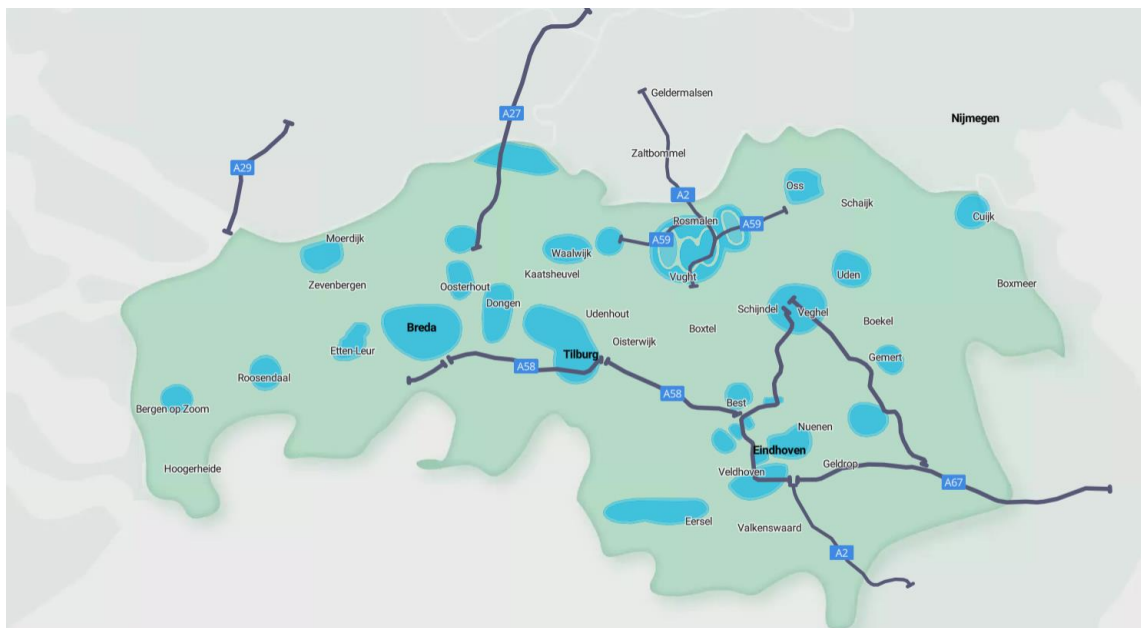


Figure 3 A map of BMN communities in the province of North Brabant (BMN, 2023)

The communities are divided between different community managers. These community managers connect with different employers, can connect employers with each other or can even connect communities to exchange best practices for example. Considering the case study at the A27 in the north of North Brabant: The approaches for smart planning and smart building are part of the project of RWS itself and are not integrally considered in this thesis. However, mobility management involves efforts of both RWS and BMN as part of the smart travel approach of RWS. Using the communities created by BMN, it is possible to look at mobility management for the A27 in the (according to RWS) desired way: On a regional scale. Closely involved with the A27 will therefore be the community manager and the project team of BMN that manage communities along the highway.

1.2 PROBLEM STATEMENT

Based on the background, the problem considered during this thesis is the lack of knowledge about the opportunities to use travel over water as a temporary alternative during periods of hindrance. This includes a lack of knowledge about the target groups for whom travel over water might be a temporary alternative. This also includes a lack of knowledge about the conditions temporary travel over water should fulfil to remain attractive to target groups.

The study will distinguish for what target groups travel over water is an alternative and will distinguish the most important conditions for the mode of transportation used to travel over water. To be able to gather more in-depth information on a location-specific basis, the Merwedeburg on the A27 will be used as a case study for this research. By using this case study, abstract problems can be redefined in order to make information more focused and specific. At the same time, the information gathered about the case study should also be made as reusable as possible for future reference. This is an important note, as the Netherlands is facing decades of maintenance and construction projects which should be able to refer to the thesis to gather useful information.

1.3 FRAMING AND RESEARCH QUESTIONS

The background and problem statement guide the research questions towards a location-specific analysis of the Merwedeburg on the A27 as this is the most focused, researchable, feasible, specific, complex and relevant situation that can be used for the study. Therefore, using the case study of the Merwedeburg at the A27, this research remains complex, but can be focused on a particular case and therefore use that as framing.

As stated before, aspects of the thesis should be reusable for future projects because the practical relevance of this research can be used in other locations and during other projects. This is an integral part of the research and will be part of the recommendations, limitations and practical relevance in the discussion. This leads to the research question:

'How and by whom can travel over water be used to mitigate hindrance during periods of (partial) road closures, in particular for the case study at the bridge over the river Merwede?'

The main research question can be split into several subquestions regarding the situation on the A27, the different options for travel over water and the research on target groups. Firstly, the hindrance and possible travel alternatives will be looked at to answer the question: What kind of hindrance can be expected during the road closures, what alternatives remain for traffic which currently uses the A27 and what is currently done on mobility management? Afterwards, the possibilities to use travel over water are further distinguished using the research question: What are the possibilities of (temporary) travel over water, what has proven successful around the world and what conditions should travel over water fulfil? When these questions have been answered, it is possible to further determine target groups and the approach of these target groups. Therefore, the final subquestion of the study is: What target groups can be identified for whom travel over water during these periods can be a realistic and relevant alternative and how should these target groups be approached to optimize the effect of this alternative?

1.4 METHODOLOGY AND JUSTIFICATION

The main research question will be answered by using subquestions. These different subquestions can be answered using different methodologies. In this paragraph the methodology and a justification for the methodology will be discussed for every subquestion.

The first subquestion concerns hindrance and mobility management: What kind of hindrance can be expected during the road closures, what alternatives remain for traffic which currently uses the A27 and what is currently done on mobility management? This subquestion will be solved by doing desk research, interviews and observations. This includes using literature from (inter-)national sources on the approach of RWS, as well as available data for the A27 and reports (amongst others using traffic models created by Rijkswaterstaat). This research will consist of information for this specific case study, as the importance of the location of the A27 and the Merwedeburg is of vital importance for the relevance of the information received. On top of that, the project team of BMN working on mobility management will be interviewed using a semi structured interview (SSI). Several observations of conversations between the project team and employers from the BMN network will also take place. During the meetings, the planning of the construction works will be explained and the employers are given the opportunity to explain how this will affect their company. An observation of at least three of these meetings will be done to gather information to complement the desk research with more case study knowledge and expertise, as well as understanding how and if the approach of BMN fits according to the employers' opinions.

After looking at the hindrance, possibilities of travel over water are looked into: What are the possibilities of (temporary) travel over water, what has proven successful around the world and what conditions should travel over water fulfil? This subquestion will also be solved using literature. However, in this case the literature can be used from worldwide researches and case studies, not only by allowing room for technological aspects of travel over water, but also looking at possible researches on traveller satisfaction for different travel options over water. Besides that, the different possibilities will be examined for their applicability on the A27 case study, keeping away from exact technological studies, but using basic features like available transportation modes on board, boat draft and segmentation of demand.

The last subquestion is: What target groups can be identified for whom travel over water during these periods can be a realistic and relevant alternative and how should these target groups be approached to optimize the effect of this alternative? This research question will be answered by using the traffic models from Rijkswaterstaat and information gathered by the project group during their efforts to contact important employers along the A27. This question also looks at characteristics of different target groups and the incentives of these target groups, looking at options for alternatives, travel distances and the characteristics of their jobs. This can be researched using the results from the desk research, interview and observations as basis to conduct a survey. The survey used will be a written survey conducted online among Dutch inhabitants and creating different target group based on statistical significance. This is done to create a general view on the opinion of potential passenger groups. Based on earlier results of the thesis, the questions will be determined. To keep it interesting, variety should be offered and attitudinal scales will be used. An example of a question can be: How willing are you to use travel over water as mode of transportation? Using attitudinal scales respondents can then answer questions accordingly.

1.5 INTERESTS AND RELEVANCE

The master thesis is part of the Master of Transportation Sciences by distance learning from the University of Hasselt. One of the conditions of being a distance learning student on this master is being employed at the time of studying. As a student I fulfil this condition with a job at the company of XTNT. In preparation of this master thesis, the University of Hasselt initiated the choice process for a master thesis topic. However, being employed at a consultancy I also took the interest of my employer into consideration. Therefore, the master thesis topic has been converted to match the interests of myself, the University of Hasselt and the consultancy of XTNT. This construction asks for clarification as it is important to explain any (commercial) interests which influence the thesis. Therefore a general clarification on the position of XTNT will be given as well as an indication of the role XTNT plays at the reconstruction of the A27 and the interests in this thesis as a product.

1.5.1 The consultancy XTNT

As a consultancy in the field of traffic and transport, XTNT is involved in many different projects. The consultants working at XTNT work alone or in teams on many different projects (at the same time) and for different clients. Located in Utrecht, the consultancy named XTNT was founded over 25 years ago. At first, it started as a consultancy which focussed mostly on traffic management and traffic engineering. However, with the arrival of the first traffic psychologist the company took a new path and expanded its view on traffic and transport. Transportation did not only consist of vehicles and networks, but rather more consists of the people in those vehicles and using the networks. Understanding them, their behaviour and their thoughts became a crucial part of the work of the consultants and this remains the same until this very day. Besides psychologists, XTNT now consists of more than 30 consultants, amongst whom there are now also experts in social sciences and communication which have helped the company adjust to the complicated and multi-disciplined projects it faces today (XTNT, 2023a).

A lot of consultants from XTNT work together with Rijkswaterstaat and other governmental organisations. Those working at Rijkswaterstaat often work in projects for a longer period of time and focus on maintenance of the most vital bridges and tunnels as described earlier. Many of the actual reconstructions projects are planned to take place between 2025 and 2030 or even later, but the consultants have been working together with Rijkswaterstaat on the preparation of these projects for years, thinking about smart solutions for hindrance mitigation, traffic management and communication. Besides that, XTNT also works for provinces and municipalities on road safety, traffic education, parking, traffic management, shared mobility and many other subjects. These projects range from small, temporary projects to long-lasting secondments (XTNT, 2023a).

1.5.2 Relevance and commercial interest on A27

As described in subparagraph 1.1.5, the employers approach by BMN is used by RWS as an important part of mobility management for the project on the A27. However, BMN is not an organisation which has a lot of employees itself. BMN deploys advisors from different consultancies to function as community managers for example, and XTNT is one of those consultancies involved in secondments to BMN. On top of that, XTNT also has roles in monitoring and evaluation of BMN, partially keeps the BMN website up-to-date and deploys one of their advisors to coordinate all cycling-related activities in the region (XTNT, 2023b). Therefore, the success of BMN is almost directly linked to the consultants of XTNT and their efforts.

Perhaps unsurprisingly, different advisors from XTNT manage the communities located in Altena, Geertruidenberg, Oosterhout, near the A27. On top of that, advisors from XTNT also manage some of the larger, important cities in the area such as Breda and Waalwijk. These communities are all located directly on or close to the A27. The direct involvement of XTNT in this project was one of the reasons for the management of XTNT to support travel over water as master thesis subject. The situation around the A27, which will be explained in-depth in the following chapters, asks for appropriate implementation of mobility management. The advisors of XTNT have an important role as their knowledge about mobility management and appropriate solutions for different situations can create new opportunities to keep the region accessible (XTNT, 2023b). At the A27, the cooperation between BMN and the national governmental organisation of RWS is of vital importance to coordinate (re-)construction activities, whilst keeping the region as accessible as possible. Developments or research that lead to new insights considering the possibilities to deploy mobility management measures help BMN and RWS to keep the region accessible.

This Master Thesis seeks answer to the questions how and by whom travel over water can be used during periods of hindrance to mitigate the hindrance. As this can lead to new mobility management solutions, the relevance of the thesis is found in the possible applicability of travel over water as new solution. This is the case for the case study at the A27, but might also be the case for future projects where waterways form barriers and simultaneously opportunities for traffic. Of course, this practical relevance of the thesis contributes to a greater social relevance, which is keeping regions accessible. The road network in the Netherlands already faces a lot of pressure and the pressure will keep growing over the next years (KiM, 2022). Inhabitants of the Netherlands will face more congestion than ever and the accessibility of entire regions will be at stake if the government does not act appropriately. Therefore, society as a whole will benefit from research into possibilities to further develop mobility management. The practical and social relevance of this thesis could possibly also make the thesis a desirable commercial product as there might be commercial value attached to new, relevant insights. However, any findings considering travel over water and target groups will be shared with multiple stakeholders such as RWS, which can use the research for the A27 and for other location-specific situations in the future. BMN can also use the research to enrich their community managers with more knowledge on this mobility management factor. This includes community managers from XTNT, but also includes advisors from other consultancies. Sharing the research across different stakeholders should make the thesis shared general knowledge, decreasing distinct commercial values but optimizing the effect on the practical and social relevance.

1.6 THESIS OUTLINE

This introductory chapter has provided background information on the research topic, problem statement, methodology, relevance and interests, among other things. Chapter 2 further elaborates on the case study of the highway A27, using desk research and interviews/observations to further gather information on the relevance of the case study and the specifics of the situation. Chapter 3 highlights relevant literature on travel over water, which is used to analyse in-use alternatives and determines the scope used during target group research. Chapter 4 presents the target group research, including the data collection methods and primary findings. The analysis and the further determination of target groups and service conditions will be presented in Chapter 5. Chapter 6 is also used for the conclusion, to discuss the research findings and to look at the recommendations and limitations of this research.

2. Case Study: Highway A27

2.1 HIGHWAY LOCATION AND NETWORK FUNCTION

The highway A27 is part of the highway system in the Netherlands which can be recognised by the name of the road starting with the letter A, followed by a number. The A27 is a connection between the south of the Netherlands, near the city of Breda in the province of North Brabant, towards the northern part of the Netherlands, near Almere in the province of Flevoland. The last part of the A27 between Huizen and Almere was completed in 1999. The total length of the highway is around 109 kilometres (Rijkswaterstaat, 2023a). The highway is an important connection between the north and the south of the Netherlands. It is directly linked to other highways, such as the A1, A2, A6, A12, A58 and A59. As the A27 offers a variety of views on rivers, nature reserves and forests the highway has been designed as a panoramic route, which offers traffic scenic views on the surroundings. Two of the most important rivers crossed by the A27 are the Lek and Merwede. The suitable names for the bridges used to cross these rivers are the Lekbrug near Hagestein and the Merwedeburg near Gorinchem.



Figure 4 Map of the Netherlands with highway A27 highlighted in red (Rijkswaterstaat, 2023a)

The highway A27 is busier than the average highway in the Netherlands. Particular stretches of the highway even belong to the list of the busiest highways in the Netherlands with more than 70.000 vehicles around Gorinchem on an average weekday, with as many as 110.000 vehicles on stretches around Utrecht (CBS, 2020). Moreover, the highway is barely able to cope with the amounts of traffic it has to handle. The ANWB, which monitors traffic on Dutch highways, concluded that the A27 between Utrecht and Breda was the biggest bottleneck in the Dutch highway network in 2022. This conclusion was the result of the total sum of congestion severity (congestion length times congestion duration) between the period of April and December in 2022, after all Covid-19 measures were lifted. Even more particular, the problems were the most intense on the stretch between Lexmond and Werkendam (ANWB, 2022). This part of highway has two lanes in both directions, has a connection with the A15 and, most notably, includes the Merwedeburg near Gorinchem. The Merwedeburg is therefore seen as one of the biggest bottlenecks in the Dutch highway system and is notorious for its congestion.

2.2 HIGHWAY RECONSTRUCTION

As mentioned in the background of the report, the highway A27 will be reconstructed from 2023 onwards, with construction being finished between 2029 and 2031. The reconstruction will take place in order to reduce congestion and thus improve traffic flow on the highway. On top of that, an indirect benefit of the improvement of the A27 is the decrease of traffic intensities and congestion on the underlying road network around the A27, which now also suffers from congestion often. At the moment, this underlying network is used by many as an alternative to avoid congestion on the A27. Because of the improvements on the A27, this should be prevented in the future (Rijkswaterstaat, 2019).

2.2.1 Construction details

The number of lanes on the highway will be increased between Houten and the connection with the A59 at Hooipolder. This is a total length of around 47 kilometres. The number of lanes can alter between three lanes or four lanes and one of the lanes on particular stretches can also function as a rush-hour lane (Rijkswaterstaat, 2019). At the same time, construction on the road also has consequences for the bridges which are currently in use. The Hagesteinsebrug, Merwedeburg and Keizersveerbrug will be completely replaced by new bridges. Other bridges are adjusted in order to make them appropriate for the renewed highway. The new road design also has positive effects on road safety, noise pollution and air pollution. On top of that, nature and the historical surroundings of the A27 will be preserved as much as possible (Rijkswaterstaat, 2019).



Figure 5 Part of the route decision plan for the A27 (Rijkswaterstaat, 2019)

Figure 5 shows part of the route decision plan which was made by RWS for the reconstruction of the A27. The part shown is the stretch mentioned by the ANWB as the most heavily congested stretch of highway in the Netherlands, between Lexmond (in the north) and Werkendam (in the south), with the connection to the A15 and the bridge over the Merwede both near Gorinchem. This entire part of the A27 will be widened, with the blue part being widened to three lanes and the orange part being widened to two lanes with an additional rush-hour lane.

2.2.2 Hindrance during reconstruction

Widening the A27 and replacing several important bridges will result in long lasting hindrance for traffic using the highway. Although RWS uses its Slim Plannen, Slim Bouwen, Slim Reizen approach (Rijkswaterstaat, 2022b), hindrance is still inevitable. Mobility management is one of the solutions to at least mitigate the hindrance, as mobility management measures should reduce the number of vehicles on the highway by around 3.000 per day. This should be most notable during rush hour, as people are stimulated to work from home, travel outside rush hour or use alternative modes of transportation (Rijkswaterstaat, 2023b). In order to stimulate thousands of road users to change their behaviour, RWS seeks cooperation with road authorities, public transport, employers and regional mobility networks. Most importantly, those regional mobility networks often already work on structural behavioural changes of road users and these organisations such as BMN often also already have a strong bond with the region.

With this approach, RWS tries to offer a wide range of measures to stimulate different target groups to travel differently during periods of hindrance and perhaps afterwards as well. This is however more difficult than it seems. An independent evaluation of the Minder Hinder approach revealed some flaws or at least points of attention in the approach. Although these points of attention were concluded based on the overarching approach of RWS which is used nationwide, the points made still indicate the effect successful mobility management can have (Bos, Kamphuis, Dreyer & Voorn, 2020):

- A lot of road users do not inform themselves sufficiently about possible hindrance on the road before their trip. This will lead to congestion time, which directly results in stress. Because the hindrance is unexpected for these road users, their experience of the hindrance tends to be very negative.
- Applications are in general more often used to navigate, determine the maximum speed or localise speed cameras, rather than being used to determine hindrance.
- Applications which can be used to determine hindrance are more often used during the trip than before a trip.
- Providing sufficient information about hindrance on the road before the trip will result in two thirds of road users choosing for a better, alternative route before leaving.
- Over a third of the road users choose to leave at a different time if they have sufficient information about hindrance.
- Around a fifth of the people will stay at home if they know about the hindrance on their route, whilst 10% choose for public transport.

These numbers show how influential and thus important mobility management can be, when implemented successfully. With the intensities of traffic being as high as on the A27, successful mobility management can actually reduce to number of vehicles on the road by several thousand every day. Most notably, two thirds of road users will choose a better alternative when they receive enough information and more than a third (which are partially overlapping numbers) will choose for a different time. Although hindrance is inevitable, cooperation between RWS and regional initiatives is important to maximize the effect of mobility management and (due to the regional character) understand what problems are important for the stakeholders in the regions, what solutions can be provided and how the community can be approached optimally to optimize the effect of the measures. BMN is therefore an important part of the approach of RWS, but only focuses on one particular target group: Employees.

2.3 INTERVIEW AND OBSERVATIONS

Hindrances around the A27 are inevitable, but BMN and RWS work together to mitigate the hindrance and help employers and employees in the region to prepare themselves for these periods of hindrance. However, using a theoretically thought-out approach and making it practical for employers in the region might be more difficult than expected. To understand how the problems around the A27 call for drastic action in terms of mobility management, an interview and several observations were conducted. The interviews and the observations are aimed at gathering information about the regional approach and the chances for effective mobility management, including travel over water.

The interview and observations provide insight into the problems and concerns mentioned by stakeholders in the area, as well as presumed solutions by BMN. Important themes included in the interviews and observations are the approach of BMN, the influence of the A27 reconstruction project on the region, the way communities are set up and can work together and the possibilities and solutions on mobility management.

2.3.1 Interview methodology

To understand the point of view of BMN and their solutions in terms of mobility management, the project team of BMN on the corridor A27 were interviewed. Because there were already several predetermined themes on which the interview would be focused, the preferred style for the interview was a qualitative semi-structured interview. The predetermined themes, which were already mentioned in the previous paragraph, were:

- The approach of BMN
- The influence of the reconstruction of the A27 on the region
- The way communities are set up and can work together
- The possibilities and solutions in terms of mobility management

Qualitative semi-structured interviews are a blend of structured and unstructured interviews. To optimize the qualitative information that is wanted during these interviews, the questions are often open-ended and the number of questions or order of the questions is not fixed, which leaves possibilities for spontaneous questions which can provide additional information. The semi-structured interview format used during the interview can be found in Appendix 1. To provide some more structure, every theme has been enriched with different examples of questions. During the interviews, not all questions had to be addressed, although these have been used as guiding questions.

Due to the project team being Dutch and the fact the main language of the interviewees was Dutch, the format (which was originally made in Dutch to match the expectations of the project team) has been translated to English in Appendix 1 to match the style of the thesis report.

A transcript of the interview can be found in appendix 2. The transcript has been written out in full, after being translated from Dutch to English. To categorise the information, the semi-structured interview format themes have been used as basic layout to make analysis of the interview possible. These themes mentioned earlier also directly function as the predefined set of codes used for the deductive coding of the interview. The deductive coding has been visualised using different colours and can be seen in Appendix 2 as well.

2.3.2 Observation methodology

Besides an interview with the project team of BMN, three observations have taken place. These observations were aimed at understanding how the employers in the region with which BMN works together, think about the A27 and to understand how they think about the ideas of BMN to successfully integrate mobility management measures. Understanding what the vantage point of employers in this region is and how they might look at opportunities given on different themes within mobility management can help determine if travel over water as a mode of transportation might be a viable alternative in a scenario such as this one.

The choice for an observation was purposely made to collect data using a systematic way of watching and listening to an interaction between BMN and the employers. An observation can help learning about the interactions between these two partners and about the behaviour and thoughts of the employers when the approach of BMN and mobility management measures are discussed. To prevent a distortive effect, a non-participant observation was chosen. The observation is in this case an addition to other research methods and not the main research method.

A total of three observations were made of conversations between the project team of BMN and a partner within the region around the A27. Upon determining possible partners of which the conversation could be observed, the project team of the A27 were asked to include partners with different characteristics and who were in different stages of the approach in order to include variety and create a more overarching view. Eventually, three different partners in three different stages were observed for this research:

- The first meeting of BMN with the management of a business park located along the A27 highway. The management was previously unknown with BMN.
- A meeting of BMN with the managing board of an employer in the region that wants to take a role in one of their communities. They have already spoken before and have to determine what steps to take next.
- A meeting of BMN with a municipality in the region. There has been a number of contact moments between the municipality and BMN, but the municipality has yet to decide whether it would take a leading role in the community.

These observations thus include different employers (business park, company, municipality) at different stages of the approach. The observations were recorded using transcription recording, with as many details of the conversation written out in order to be able to look at the positive comments or objections used during the interaction. This had two advantages. In the first place, these detailed notes help understand the conversation between BMN and the employer. Any positive comments, objections or other important additions can be directly traced back to the text. On top of that, using a transcript also makes it possible to link the themes used in the interview with the project team from BMN to the observations. This eventually makes it possible to cross-analyse the data from the interviews and the observations.

Using the predetermined themes, the possibility arises to use descriptive coding on the transcript of the observations and match the qualitative data from the interview to any observed reasoning during the observations. The transcripts of the observations can be found in Appendix 3 and have been used together with Appendix 2 as input for the next paragraph.

2.4 INTERVIEW AND OBSERVATION FINDINGS

2.4.1 BMN and the cooperation with RWS

In the interview with the project team (Ilse van Zijl and Ingeborg Haers) from BMN, they explained what they try to achieve with their efforts in the region. The words normally used to describe what BMN does in the region are ‘inspire, connect and advice’ (Figure 6). However, by many BMN is mostly seen as an employer’s approach. BMN supports the development of more sustainable mobility and tries to help the region. This once started with an initiative from the province of North Brabant, but has now also developed into a cooperation with RWS on the corridor A27.

BMN takes different steps together with employers to ensure more sustainable mobility in the region. In the first place, BMN has several different tools which they can use. With these tools, they look at the possibilities to improve the situations of employers, possibly by changing policies, but also by providing more information on measures or actions that can be taken without directly influencing company policies. On the other hand, Van Zijl mentioned how BMN also connects employers with other partners, such as knowledge institutions, educational institutions, municipalities or others. Connecting these employers with each other and with other institutions is therefore deemed one of the crucial strengths of BMN according to Van Zijl (Appendix 2).



Figure 6 The approach of BMN in 4 steps (BMN, 2023)

As mentioned earlier, the corridor on the A27 was originally not a location where BMN was focused on. However, since the reconstruction has been announced the highway has become a point of concern for the region. The project team now uses the A27 as an external cause for employers in the region. Using the A27 as a cause, they want to initiate conversation and use the hindrance as a compelling moment to initiate change.

Haers mentioned that the region has its own difficulties. Public transport is not very accessible and has been seen as an alternative by only few. Therefore, public transport is not a theme which is used to stimulate sustainable transport, according to Haers (Appendix 2). This might also influence the opportunities for travel over water, as connections with public transport might be rare and thus insignificant to the inhabitants or travellers in this region.

Cooperation with RWS has been positive from the beginning. BMN is expected to reach out to a certain number of employers in the region. In their mutual meetings, BMN and RWS look at new trends or opportunities and discuss feedback for the past periods (Appendix 2). The fact that the success of the approach of BMN is measured in the number of companies they have approached is perhaps logical, yet also interesting. Because BMN acts as an employer's approach, they want to build communities. However, the eventual goal of RWS is to mitigate hindrance by reducing the number of vehicles on the A27 by at least 3.000 per day (Rijkswaterstaat, 2023b). The reduction of traffic is largely the outcome of actions taken by BMN, yet BMN will not be evaluated on traffic reduction. The mobility management advisors from RWS thus have a leading role in connecting the mobility management possibilities with BMN.

During the observations, Van Zijl and Haers indeed used the reconstruction of the A27 as the reason for their approach. Employers are warned about the reconstruction of the highway and the hindrance that will be the result of this reconstruction. Both also stress how BMN and RWS work together, mostly indicating that RWS is working on the best possible planning for construction, whereas BMN itself is mostly aimed at easing the pain and coming up with sustainable measures. When mentioning the delays on the highway (between 10 and 30 minutes for a single trip), Van Zijl also mentions how the underlying road network will be affected by the hindrance caused by reconstruction as well (Appendix 3).

All observed employers acknowledged the problems and hindrance the reconstruction of the A27 would cause. For example, the management of the business park noticed that 'the A27 will be a concern for the employers, employees and customers'. This indicates that the employers do know what is coming and also know they have to act to remain accessible, not only for their own direct benefit, but also to remain accessible to possible customers. Employers have also received information from other sources, such as through online-sessions and other exchanges of information (Appendix 3). When all observations are considered, the employers seem to have a good understanding of what is going to happen. Their acknowledgement of the hindrance and understanding that their contribution can help mitigating that hindrance is crucial.

2.4.2 Community building and mobility management themes

BMN works with communities to bring employers into contact, but also to set up mobility management measures on a larger scale. Starting with an individual approach in the beginning, BMN afterwards tries to bring companies together based on geographic locations. A clustering of companies is often used to create mutual understanding of the problem and create a community. In the region around the A27, three separate communities were created (Appendix 2). In some cases, there will be 'leading companies' within a community that act as an example for others in the region. This can be a company, but it can also be the municipality.

This approach seems to make employers enthusiastic. The idea of helping each other forward in a community is something which is repeated by the employers during the observations. After the initial explanation by the project team, the employers mention they want to 'look at what we can do as businesses altogether', 'meet with other employers' and 'be one of the examples for other employers'. These three quotes all originate from different employers. This does stress the ambition of the different employers which were observed to actually participate and even act as leading companies (Appendix 3). It also indicates their desire to work together instead of solely.

Purely based on the observations, the companies appeared to be reluctant to act on their own. Although during all observations some direct mobility management measures were mentioned, the employers constantly referred back to the possibilities to work together with others on overarching mobility management measures. At the same time, Van Zijl and Haers did support the idea to work together in the communities, although some eagerness for a direct impact was also noticeable. The best example was the meeting with the community, in which Van Zijl and Haers stressed the importance of pitching the all-in approach to the alderman (Appendix 3).

In terms of converting this to useful information for travel over water, it would also mean that including travel over water as an opportunity within the community would probably be beneficial for the success of this form of transportation, which of course also depends on the enthusiasm of employees to actually use this new mode of transportation. Together with the individual companies, but mostly with communities, BMN determines on what themes within mobility they want to focus (Appendix 2).

There are eight themes within the domain of BMN, which can be seen in Dutch in Figure 7. Starting on the top left, the themes are: 1) Working from home and spreading traffic, 2) Public transport, 3) Travel allowance, 4) Cycling stimulation, 5) Parking policy, 6) Traffic safety, 7) Vehicle fleet and electrical vehicles, 8) Behaviour and communication.



Figure 7 Eight themes for employers to start working on sustainable mobility (BMN, 2023)

Based on the ambitions of the companies or communities, the choice is made on which themes will be focused. Notably, travel over water is not one of the important themes mentioned in the approach of BMN. If any, travel over water is part of the location-specific measures on the A27. Besides that, there are several interesting opportunities for employers to create more sustainable travel. If travel over water is indeed a good solution for employees, this should become an integral part of the approach of BMN. If not, this theme should not be included in the general themes used by BMN for their approach around the A27.

2.4.3 Employer enthusiasm and concern on mobility management

The ultimate goal of the approach of BMN for the project on the A27 is implementing successful mobility management and reducing the number of vehicles using the A27. Because of the severe effects on the road network in the region, mobility management is necessary to keep the region accessible. During the interview and observations Van Zijl mentioned how the underlying road network will also suffer from extra hindrance. Delays on a normal day will be between 10 and 30 minutes for traffic passing the Merwedeburg. However, there are also going to be days or even weeks in which the bridge can be closed entirely. RWS will plan these closures during weekends, nights or holidays, but the fact is that mobility management is simply the best way to keep the region accessible (Appendix 2).

The most important themes mentioned in terms of mobility management during the observations are cycling stimulation and working from home. As cycling stimulation is not a new theme in the Netherlands, all employers recognised this theme and mentioned previous efforts, along with drawbacks from earlier experiences. These drawbacks include a lack of support (mentioned by the employer), the influence of bad weather (mentioned by the business park) and the lack of support in employer policy (mentioned by the municipality). Working from home or changing working times was another one of those themes mentioned often, but during the observations this theme was also exposed to some drawbacks. Most notably, employees can depend on company cars or buses, as well as being obliged to be at a certain place during their work. At the same time, multimodal travel options are also discussed during the conversations between BMN and the employers. However, during the observations the employers showed almost no direct interest in travelling with multiple modalities for one journey. Travelling 'differently' is seen as an option, but once both parties tried to get more into the details, they often turned to cycling stimulation or working from home as most general solutions for the problem. This was most notable during the observation of BMN and the business park (Appendix 3).

During all three observations, the employer recognised the need for mobility management and acknowledged their company to be part of the region which will be impacted. On the other hand, solutions in terms of mobility management which were provided by BMN were mostly objected based on previous experiences from the employer or expectations of the employers based on the nature of their company and employees. The employers all favoured the approach in communities, as they mentioned how communities can help mobility management because certain solutions can be provided for a bigger audience at the same time. However, during the second observation the employer also mentioned how their situation was unique and different from other companies, which means customization of the solutions provided by BMN would be necessary to fit their company (Appendix 3). BMN would in this case benefit from more specific and accurate information on the solutions that can be provided in the region, not only for a single company but also for the region as a whole.

In terms of opportunities to provide an alternative in mobility management, travel over water has been looked at already, but not in-depth. There are currently already some ferries in the region and the question is whether extra boats can be used during periods of hindrance. However, apparently to Haers, it is currently unknown for who travel over water can be a viable alternative. If RWS and BMN did know, they could also use it as part of mobility management (Appendix 2). This is important for the survey, as determining if employees is the most promising target group will have effects on the themes of BMN.

2.4.4 Interview and observation conclusions

Based on the information gathered during the interview and the observations, there are several conclusions which can be drawn from these research methods and which will have to be taken into consideration during target group research. Conclusions can both have results for the possibilities to support travel over water in this region, which will be more closely looked at in paragraphs 2.5 and 2.6, as well as in Chapter 3. Conclusions can also be aimed more specifically at the target groups for which travel over water can be an opportunity, which will be more closely looked at in Chapter 4 and 5. All conclusions drawn:

- BMN and RWS work together on mobility management for this project.
- There are eight themes on which BMN focuses in their approach. Some of them are specifically aimed at mobility management. Of those themes, public transport is not seen as an opportunity for the region around the A27. Seven themes remain.
- The lack of public transport in the region and the intention not to improve the situation as part of mobility management can influence the opportunities of travel over water.
- Travel over water is not one of the themes of BMN. It is part of mobility management which is mostly developed by RWS. However, if travel over water is a promising alternative, BMN should integrate this opportunity in their approach. This is only true for the communities which are directly affected by the hindrance on the A27, as the hindrance is used as an external cause in these situations.
- It is currently unknown for who travel over water is a viable alternative and it is therefore hard to estimate how big the impact of travel over water can be compared to other mobility management measures.
- Employers in the region are concerned about the reconstruction of the A27 and their accessibility. They are keen on more information about the situation and want to work together with other employers to think of solutions. At the same time, every employer is unique and mentions why they are unique in their own way.
- Looking at cycling stimulation, which is often seen as (one of the) most important parts of mobility management in the Netherlands, there are multiple drawbacks which were mentioned by the employers. For example, employees do not like cycling through the polders, live too far away or have to travel with a car/bus from the company. These factors also influence the opportunities for travel over water.

The conclusions mentioned have influence on the remainder of the research, as concerns and specifications mentioned by BMN and the employers can be taken into consideration in the survey. Eventually it will be important to determine whether employees should be the most important target group of travel over water. Subsequently, if employees are not regarded as a target group for which travel over water is generally interesting, other target groups besides employees might be identified on the road network which might be more interesting. If any other target group is identified, it could be possible to determine other methods than the approach of BMN to reach these target groups.

To determine this, it is important to first identify the other target groups, and based on their characteristics include target groups in the survey which will be used as dominant research method. The next paragraph will therefore focus on possible other travel motives and travel modes that influence the transportation network around the Merwedeburg.

2.5 DUTCH TRAVEL MODES AND MOTIVES

The approach of BMN is the most influential mobility management approach for the A27. However, the approach only focuses on the employers and employees in the region, using the corridor A27 as vantage point and involving only this particular target group. The approach of BMN does not consider any travellers with other motives. Of course, this has a reason. When considering all the different modes of transportation in the Netherlands, the total distance travelled in the last year without Covid limitations, which is 2019, was around 219 billion kilometres. Around 148 billion of those were made in cars, with other modalities such as the train and bicycles only contributing for a total of 32% of the travel distance altogether (CBS, 2022).

Looking at the relative amount of trips in which a mode of transportation is used, cycling and walking are the most dominant on short distances, with the average cycling trip being only around 4 kilometres and the average walking trip around 2 kilometres. The average trip in a car in the Netherlands is around twenty kilometres in length (CBS, 2022). With the A27 being a highway and the area around the A27 not being a highly urbanized zone, the average length of the trips in the region around the A27 is assumed to be relatively high, which favours the car more than other modes of transportation. BMN focuses on the employees, also because the car is the most used mode of transportation to and from work in the Netherlands. In 2021, more than 70% of the distance travelled to and from work was made by car (Figure 8).

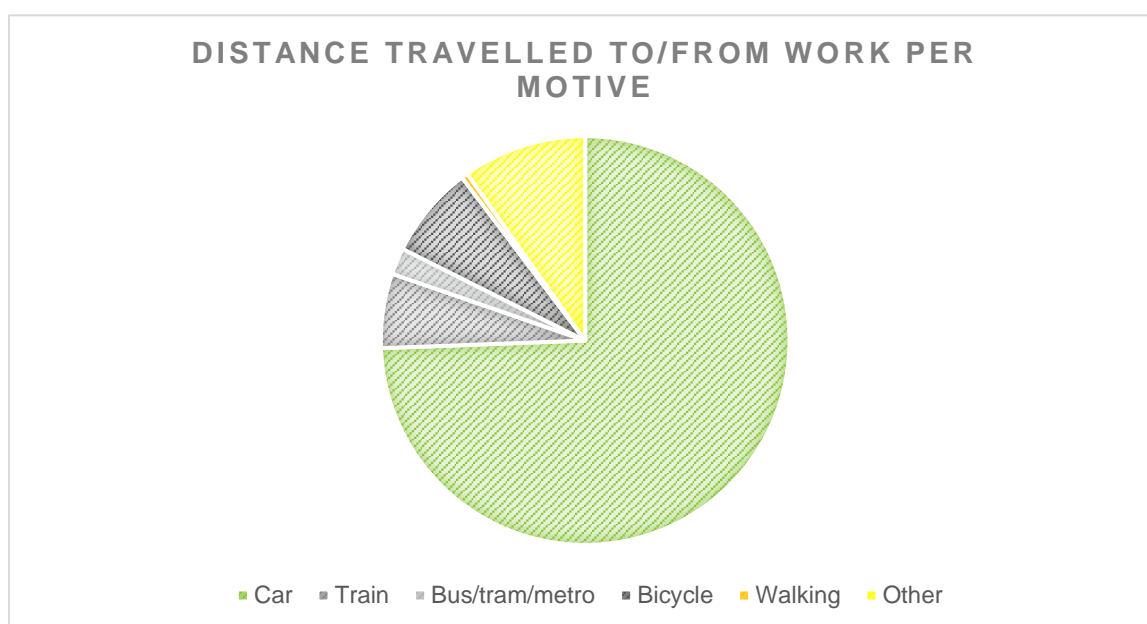


Figure 8 Distance travelled to/from work per motive (CBS, 2022)

Applying this statistic to the region around the A27 and the Merwedeburg, the relative amount of trips made with cars is expected to be even higher. As mentioned earlier public transport, which is barely available in this region, is not seen as an alternative. 8% of travel distance in the Netherlands is facilitated by public transport, such as trains, buses, trams and metros. When these alternatives are eliminated from the equation, only travelling by car, bicycle and walking seem adequate options in the region around the A27. This might explain why BMN and RWS are focused mostly on the employees in the region, as the share of the employees in car traffic is relatively high. However, other target groups should be taken into account as well.

On the other hand, when looking at travel motives of travellers in 2021, the distance travelled for work related trips (to and from work as well as other trips with a business motive) make up a total of only 30% of the total distance travelled in the Netherlands and contribute to around 20% of trips made (CBS, 2022). As this is the most important motive in terms of distance travelled and an important motive in terms of the number of trips and trip length, this has become the focus of BMN. Other important motives that contribute to these totals are trips related to shopping, sports or recreational trips. These motives are not targeted within the approach of BMN, but can have a lot of influence on the situation around the A27. In Figure 9, different travel motives and their contribution to trip length, number of trips and distance travelled can be seen.

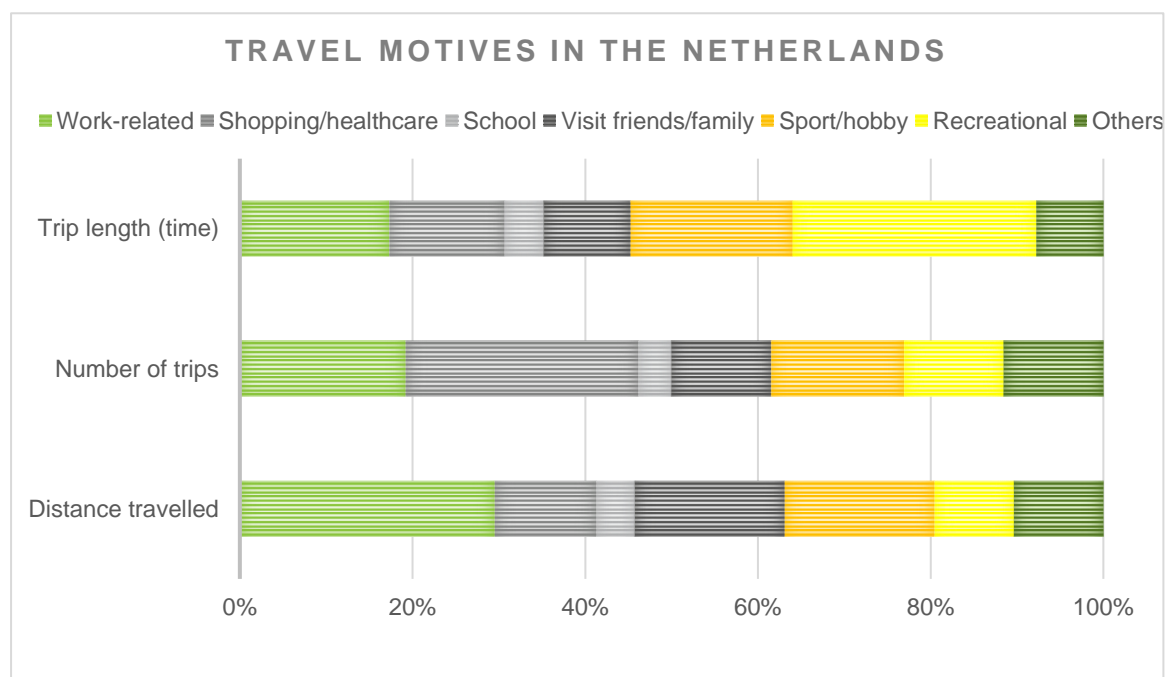


Figure 9 Travel motives in the Netherlands in 2021 (CBS, 2022)

As mentioned, the contribution of work-related trips is around 30% of distance travelled and less than 20% for the number of trips and trip length. Shopping and healthcare relatively contribute to the most trips, whereas the recreational trips amount to the most time.

With the average Dutch person (older than 6 years old) making around 2,7 trips per day, only around 0,6 trips per day per person are work related. All other motives together contribute to the remaining 2,1 trips per day per person (CBS, 2022). These motives are not taken into consideration in the approach of BMN, which solely focused on the employees in the region. When considering the relatively large contribution of the car on the modal split for trips to work, this might seem logical, but when considering the relatively small contribution of work related trips to the trip length, number of trips and distance travelled, this raises the question whether the focus for the A27 should be broadened. Of course, this research does not question the approach of RWS, BMN or their efforts to address the employees. However, to determine how successful travel over water in this region can be, it is vital to include all possible target groups, also differentiated on travel motives. The possibilities to include travel over water might therefore eventually also be focused on target groups outside of the framework in which BMN operates.

2.6 MERWEDEBRUG ALTERNATIVES

To understand how critical the situation will be when the Merwedebrug will be closed, the alternatives for the Merwedebrug have to be considered. During reconstruction, there are two possible forms of hindrance:

- Partial closure: This means that the capacity of the bridge will be decreased during a certain period of time. This can either be because of closure of particular lanes on the bridge, or the result of lower speeds and narrower lanes because of the presence of construction workers and equipment on or around the bridge.
- Complete closure: The most extreme situation which causes the most hindrance for the Merwedebrug is a complete closure of the bridge for traffic. Although the amount of time the bridge is completely closed will be as low as possible, this situation cannot be completely prevented.

Rijkswaterstaat (2023a) currently only provides general information on the hindrance which will be the result of the reconstruction of the A27. Their estimation of between 10 and 30 minutes of extra travel time is not location specific, neither has it been linked with dates. This is because they are currently still researching how good the surface beneath the current A27 is and how it can be used for the new A27. Based on the results of the preliminary investigations, the definitive planning will be made. This means it is still unknown how long the Merwedebrug and other parts of the A27 will face partial closures or even complete closures.

2.6.1 Alternatives by car

To understand why the situation around the Merwedebrug is so difficult, the alternatives have to be considered. The Merwedebrug crosses the river Merwede near Gorinchem and offers a fixed connection for all traffic on the road, as well as cyclists and pedestrians. The Merwede itself is one of the most important rivers within the Rhine delta and crosses the Netherlands practically from east to west. Crossing the Merwede (which is first called Waal in the east and which changes names several times in the West) on a fixed connection, such as a bridge, is important for north-southbound traffic. Looking at the first fixed links east and west of the Merwedebrug already creates an image of the importance of the Merwedebrug.



Figure 10 Indication of fixed cross-river alternatives (OpenStreetMap, 2023; adjusted)

The first bridge over the river Merwede west of the Merwedebrug, is called Merwedebrug Papendrecht and is located in the border of the cities Papendrecht and Dordrecht. Driving between both of the bridges would take at least 20 minutes, with more than 23 kilometres to be driven on several different highways. In the east, the same applies to the Martinus Nijhoffbrug near Zaltbommel, which can be reached in 20 minutes from the Merwedebrug, with a distance of almost 26 kilometres to be travelled.

The A27 directly links the regions around Breda and Utrecht with each other. During a partial closure, the average delay of around 20 minutes mentioned by RWS can be used to determine travel times on the A27. However, there might also be routes in the region that take less than 20 minutes and which thus become more interesting for traffic during periods of hindrance. On top of that, during a full closure traffic has to use deviations or travel differently in all cases. As there are only few bridges over the river Merwede (Figure 10), the deviations do have quite an impact on the route itself. In Figure 11, the A27 can be seen highlighted in green. The Merwedebrug can be seen as a red star near the village of Werkendam in the center of the figure. As the Merwedebrug is partially or fully closed, traffic on the A27 can use or has to use one of the deviations which can be seen in yellow in Figure 11.



Figure 11 Deviations for the route between Breda and Utrecht (OpenStreetMap, 2023; adjusted)

The western connection from Breda to Utrecht runs over the A59, the A16 and the A15. The deviation is around 40 kilometres longer than the direct route over the A27 and takes at least 25 minutes more. The eastern connection between Breda and Utrecht over the A59 and A2 takes at least 20 minutes more and will add around 25 kilometres to the route distance.

Depending on the origin and destination, the average deviation distance and travel time changes. The further away the origin and destination are from the Merwedebrug, the better the options are in most cases. Anyone living in Zevenbergen for example, which can be seen near the southwestern most point of the deviations, can reach Utrecht over the A16/A15 instead of the route over the Merwedebrug and this will only take 4 minutes of extra travel time. However, any traffic between Werkendam and Gorinchem, which is normally a route which only takes 14 minutes over the Merwedebrug, will be impacted much heavier. Their travel time will increase by around 40 minutes as their journey over the A15, A2 and N322 is more than 5 times as long (57 kilometres) as the original journey (11 kilometres). Depending on the origin-destination, other travel opportunities and travel motives amongst other factors, the choice to use one of the deviations will be made. This will be important information to include in the survey in chapter 4.

2.6.2 Alternatives over water

Zooming in on the area around the Merwedebrug itself, there is another opportunity besides using the deviations for cars, which is travel over water. Around the Merwedebrug, different ferries cross the river Merwede and connect villages around the river. The ferry services are run by a company called Riveer. There are different ferry services (Riveer, 2023a):

- Ferries Gorinchem-Woudrichem, Gorinchem-Sleeuwijk and Gorinchem-Werkendam-Hardinxveld: Ferries only accessible by foot or bicycles (capacity approximately 100 persons), which operate on a set timetable which can be found in the application of Riveer.
- Ferry Loevestein-Fort Vuren: A ferry only accessible by foot or bicycles between some of the historical landmarks in the region.
- Ferries Brakel-Herwijnen and Aalst-Veen: Ferries accessible by bicycle, foot but also by cars, lorries or agricultural vehicles.

The ferries of Riveer are located on the river Merwede, mostly around Gorinchem. The ferry services towards Werkendam and Hardinxveld even travel beneath the Merwedebrug, indicating the ferry can be a good alternative for traffic which would normally use the Merwedebrug. In Figure 12, the network of Riveer can be seen.



Figure 12 Network of ferry services by Riveer in the Merwede (Riveer, 2023a)

According to the timetable of Riveer, the ferry services for pedestrians and cyclists depart every 30 minutes on weekdays, starting around 6:30 in the morning with the last departures between 17:30 and 18:00 in the afternoon. During weekends the services are less frequent, which means only one departure per hour with the first departure around 8:00 in the morning. On Sundays, departures are even less frequent as there are no departures until approximately 12:00 (Riveer, 2023b).

The ferry used for the historical landmarks Slot Loevestein and Fort Vuren normally only operates during Saturdays and Sundays as this ferry is aimed at recreational traffic. During July and August, the ferry also operates during weekdays. The ferries Brakel-Herwijnen and Aalst-Veen operate entirely differently. As they have a direct cross-river connection, they keep operating back and forth between the river banks quickly. The ferry at Brakel-Herwijnen departs every 15 minutes based on a schedule, whereas the connection between Aalst and Veen only departs based on actual attendance (Riveer, 2023b). Besides these standard ferry services, Riveer also offers water taxi services on request.

During the years, there have been multiple studies on the viability of the ferry services. In February 2017, the consultancy Mobycon conducted the last of those studies. Looking back at the predictions made in 2008 when the service between Gorinchem and Werkendam was initiated, Mobycon (2017) concluded the number of passengers estimated to use the ferry services in the business case was far too optimistic. Despite predicting 390.000 passengers on the links between Gorinchem, Werkendam, Sleenwijk and Hardinxveld in the business case, only around 170.000 were actually realised in 2015. After conducting a survey on the passengers of the ferries, Mobycon concluded that:

- The majority of passengers on the ferries of Riveer (around 77%) only travel a total distance of less than 10 kilometres. This is true both during weekdays, as well as during weekends and Holidays.
- During weekends and Holidays, more than 50% of the passengers on the ferries have a recreational motive for their journey. During weekdays, this number drops towards 30% as other motives such as traveling to school (33%) or travelling to work (21%) take a more dominant position. Social/Shopping motives reach around 17% during the weekend.
- The reason the travellers on the ferry choose the ferry as their mode of transport is mostly because it is the fastest way to complete their journey (45% during weekdays). During the Holidays, 40% of passengers choose the ferry because it is the most enjoyable way to complete their journey.
- 30% of passengers on weekdays use the ferry every weekday. Around 60% of travellers on weekends and holidays use the ferry once per month or even less.

These statistics clearly indicate how the ferry is partially used as frequent mode of transportation to reach work or school during weekdays. On the other hand, looking at travel motives and frequency it is also obvious the ferry is mostly used for recreational trips during weekends and Holidays. Mobycon (2017) also looked at the travel patterns between Gorinchem and other cities or villages in the region. Cross-river travel seemed quite frequent in their research. For example, almost 900 people travelled from Werkendam to Gorinchem on weekdays, almost 600 people travelled from Sleenwijk to Gorinchem and more than 500 people travelled from Woudrichem to Gorinchem. Looking at the number of visitors from Werkendam and Sleenwijk, the researchers concluded that there are strong connections between the villages around the river Merwede.

However, the ferry services do not have a dominant position in the modal split when it comes to these travel patterns. Although more than 2.000 travel between Gorinchem and Werkendam every day, the ferry between both villages only serviced around 187 passengers according to Mobycon (2017). This amounts to a total of 9% of the modal split and only 4% when it concerns a trip back and forth between the two villages. The service between Gorinchem and Sleenwijk is slightly more successful, with a total of around 17% on the modal split. Between Werkendam and Hardinxveld, the modal split differs between weekdays and weekends, as the ferry only accounts for 8% of the modal splits on weekdays and 4% during the weekends.

To determine the impact travel over water can make during periods of hindrance, in particular around the Merwedeburg, the target groups have to be determined and (inter)national literature has to be consulted. After that, the statistics from this paragraph can be used to determine the actual number of trips which can be facilitated by means of travel over water.

2.7 CONCLUSION

The research question which was to be answered in this chapter was: What kind of hindrance can be expected during the road closures, what alternatives remain for traffic which currently uses the A27 and what is currently done on mobility management? One of the most important conclusions is that the situation around the Merwedebrug will indeed cause a lot of hindrance in the region. Average delays of around 20 minutes on the A27 will be a problem for traffic for years. Partial closures of the Merwedebrug contribute to these delays, but full closures of the bridge will impact the region even more heavily. RWS has yet to reveal the full planning, which means it is currently unknown when the bridge will be partially or fully closed.

RWS and BMN work together closely to prepare employers and employees in the region for the hindrance which is yet to come. These efforts on mobility management should provide employers with enough opportunity to change travel patterns of their employees and use viable alternatives instead of the Merwedebrug. At the same time, the lack of public transport in the region means RWS and BMN will not encourage employers to use public transport as an alternative. Travel over water can be used as an alternative, but at the moment RWS and BMN do not know what target groups actually think travel over water is an alternative and would use a ferry, for example. Therefore, it is not one of the themes which is addressed in their approach towards employers. However, BMN can use every viable alternative as there are not many themes adequate for this situation. Cycling stimulation, which is often the most important part of mobility management in the Netherlands, has multiple drawbacks in this region and is therefore not really seen as alternative by employers. This means demand for other possible solutions, such as travel over water, is high. Employers in the region want to work together with other employers in the communities of BMN in order to learn from each other and use large-scale solutions. They are genuinely concerned about the reconstruction of the A27 and the hindrance this will generate. This will negatively impact their accessibility and are keen to receive more information on the definitive planning. Employers stress how every company is unique and faces its own challenges. A major drawback for travel alternatives proposed by BMN is the usage of company vehicles as mode of transport by employees, which makes the situation even more complicated.

However, RWS and BMN now focus on the employers in the region, whereas many other target groups can be identified. Although the car is (by far) the most popular means of transport to travel to work, it only contributes to 30% of the total distance travelled and around 20% of the number of trips made in the Netherlands. Other important motives include going to school/study, visiting shops/healthcare, visiting family/friends or recreational trips. These are not addressed in the approach by BMN. Looking at travel alternatives for all traffic over the Merwedebrug, there are two important options if cycling and public transport are seen as uninviting alternatives. On one side, traffic could be diverted over other bridges in the region, which would also cost around twenty minutes more on average. On the other hand, travel over water by the ferry services of Riveer is a major opportunity. These services are mostly used by local traffic with school/study or recreational motives and only contribute between 9% and 17% of the modal split of local traffic between villages. Determining what target groups can use this service will indicate what part of the modal split ferry services can contribute to and can prove if waterway connections can be made viable on temporary situations. The most important conclusions which can be drawn from the research into the Merwedebrug case study, interviews and observations will be used as research results as well as input for the survey which will be addressed in chapter 4 and chapter 5.

3. Travel over Water

3.1 WATER TRANSPORT

Water transport is any form of transportation which is used to travel over water. There are many different types of water transport and water transport can be used both for cargo and for passengers. The vehicles can be split into different categories. For example, vehicles can be differentiated based on the way they are powered. A row boat is powered by humans, whereas sailboats are powered by the wind and motorboats are powered by motors. However, within each of these categories, there is still an abundance of different vehicles. To be able to categorize these vehicles, two different types of services have been identified which correspond with the services currently available at the case study around the Merwedeburg: Ferries and water taxis. Of course, the vehicles currently used by Riveer around the Merwedeburg are of particular types. In this literature research, other types of ferries and water taxis will also be taken into account.



Figure 13 Typical ferry by Riveer (Riveer, 2023a)

By consulting (inter)national studies on ferry services, it is possible to determine opportunities for the situation around the Merwedeburg. Riveer currently has some designated ferries (Figure 13) and operates according to their own timetables, but (inter)national research might provide causes to change the type of vehicle, change operational hours, change the network approach or change other factors to be able to optimize the viability of travel over water during periods of hindrance. Of course, the impact of possible changes also has to be assessed, determining whether any changes to optimize the services are actually feasible within the case study at the Merwedeburg. This will be discussed later in this chapter, as well as taken into account during the survey. The conclusions from this chapter will be combined with the conclusions from chapter 2 as input for the survey in chapter 4 and chapter 5.

In this paragraph, a brief introduction on the different services will be provided, as well as insights in current services and possible differences between those services. The remaining paragraphs of this chapter will look in-depth at the different services, research conducted on success of the services, research conducted on passenger and cargo demand and research conducted on (temporary) local network viability. Eventually, the following research question will be answered in this chapter: What are the possibilities of (temporary) travel over water, what has proven successful around the world and what conditions should travel over water fulfil?

3.1.1 Ferry services

When travel over water is discussed in our network of transportation, there is often attention for services by ferries. A ferry is then seen as the most useful type of boat to carry passengers and sometimes cargo over relatively short distances. Ferry services have existed over a long period of time. The possibility to build longer and better bridges and tunnels has in some cases eliminated ferry services, but services are still provided on links where fixed crossings are unfeasible (Britannica, 2023a).

However, there are many different types of ferries. Ferries can offer overnight cabins and cruise ship like accommodations when on longer runs, but can also simply consist of a simple single-deck vehicle with low-level doors. Examples of these small ferries can be found throughout the world, mostly in harbour locations or on rivers. These ferries are similar to the ferries of Riveer in the river Merwede and can provide cross-river opportunities for cyclists and pedestrians, but also often for cars or even lorries (Britannica, 2023a).

When consulting ferry operators however, the most notable operators are the long-haul ferry operators. In all continents (except from Antarctica), ferry operators provide services between countries or even continents. Examples are plenty. African based Algerie Ferries provides ferry services between Algeria, Spain, Italy and France in the Mediterranean Sea (Algerie Ferries, 2022). Asian operator 2GO Travel provides long-haul interisland ferry services in the Philippines (2GO Travel, 2023). Danish operator DFDS Seaways operates in large parts of the Baltic Sea and North Sea in Europa (DFDS, 2023b). Similar operators are active in Oceania (mostly interisland), North America (interstate) and (although less frequent) South America. Depending on the operator, the type of vehicle used as ferry changes. In paragraph 3.2, these large-haul services will be looked at in-depth.



Figure 14 Dartmouth lower ferry in the UK (South Hams District Council, 2008)

On the other end of the scale, local ferry services are mostly located within urban region and form local ferry networks or, such as the Dartmouth Lower Ferry (Figure 14), are located in smaller urban areas and act as stand-alone transport lines. Examples of local ferry networks can be found around the world as well. Well-known examples are the Waxholmsbolaget in Stockholm, Istanbul Ferry Network in Istanbul, Sydney Ferries in Sydney, GVB Ferries in Amsterdam and Star Ferry in Hong Kong. Many of these networks process millions of passengers annually. In paragraph 3.3 the local services will be looked at more closely.

3.1.2 Water taxis

Another type of service, although less known than the normal ferry service, is the water taxi. Water taxis differ from the normal ferry services because unlike a ferry, a water taxi does not have to follow a predetermined schedule (Task Force on Water-land Interface, 2012). Famous water taxi operators are found in Rotterdam (Figure 15), Amsterdam, Sydney, Boston, New York, but also in many large cities in Asia, such as Hong Kong. A city famous for its transport over water, which includes many water taxis, is Venice.



Figure 15 Water taxi located in Rotterdam (WatertaxiRotterdam, 2023)

Research on water taxis in Hong Kong acknowledged how water taxi services are a growing business in many major cities worldwide. The small vessels carry passengers to customer specific locations, instead of network specific locations. This of course also impacts the price, which is often not (like ferries) based on a specific network route, but more often on a starting price with an added fee for a certain time or distance (Baez et al., 2018). The future development of the water taxi in Hong Kong depends on many different factors. The developments in and around the harbour, which should suit water taxi type service locations, is the first of those factors. Current water taxi services are seen as the second factor and the public interest in the water taxi services is the third factor (Baez et al., 2018). The importance of the infrastructure supporting water taxis is also mentioned by Van Berkel (2020). His assessment of the connection between the number of jetties for water taxis and the passenger travel time in the urban area of Rotterdam found that (with a preselection of passengers who are able to use water taxis) the reduced travel time increases from 105 seconds if only two jetties are allocated to 517 seconds when 22 jetties are allocated (Van Berkel, 2020). This increase in reduced travel time is the result of the direct link between passengers travel demand and water taxi service which, unlike a predetermined ferry route, links passengers to the best jetty or jetties over the shortest distance or, preferably, the fastest. Research on water taxi service in the Han River in Seoul in 2009 also mentioned the importance of the economic situation on the success of water taxi services. The economic problems following the financial crisis in 2008 had a heavy impact on services in the Han River. Accessibility, informativeness and convenience were the most important improvements to be made after the economic problems had been solved to increase water taxi user service (Kim et al, 2009).

The water taxi service is different from the ferry service in many ways. Whereas ferry services work with predetermined routes, jetties and networks, the water taxi is a much more flexible way to travel over water. Having said that, water taxis are therefore also more expensive for travellers and the operators have to rely on enough passenger demand and convenient infrastructure to make water taxi services possible. Although little research has been carried out into the viability of water taxi services, this particular service will be taken into consideration during this research as well.

3.2 LONG-HAUL FERRY SERVICES

Long-haul ferry services are available throughout the world and there are many different operators that run regular ferry services between large cities, countries or even continents. Because of the large size of the ships that can be used, it is sometimes hard to identify a ferry or a small cruise ship. Long-haul ferry services have been known for hundreds of years. In the 1830's, the Great Western Steamship Company already connected the United Kingdom with the United States. The flow of ships was of such a scale and continuity that it earned the name 'Atlantic Ferry' (Britannica, 2023b). In the decades after that, European countries sought to dominate passenger services between Europe and the United States, which meant ships got bigger, more luxurious and faster. Examples are well-known, such as the much anticipated and renowned Titanic which is also the result of this competition.

Until World War II, ocean liners kept growing and the competition between the United Kingdom, Germany and France was fierce. However, during World War II many of the ocean liners were used as troopships and were fitted differently than intended. After the war, ocean liners kept dominating the trans-Atlantic trade until the 1960's. The introduction of the jet airplane stole most of the trade of the Atlantic ferry (Britannica, 2023b).

Although the case study around the Merwedeburg does not reflect any of the situations mentioned above, literature research on these long-haul ferry services can provide insights into positive motives and drawbacks faced by ferry services which can possibly also be applied to smaller scaled services such as the services from Riveer around the Merwedeburg.

3.2.1 Characteristics of long-haul services

These services have been of interest to researchers over the past decades and research into the factors that contribute to the success of the ferries and opportunities to optimize the transportation network using ferries is plenty. Factors that determine the general availability of a ferry service which spans a larger distance are directly linked with the past and the present. Research by Baird back in 1997 blamed the lack of ferry services between Scotland and the mainland of Europe on a lack of existing seaport infrastructure, as well as a lack of sufficient government initiative to promote links. Therefore, the modal split in Scotland did not have benefits of the ferry service as a mode of transportation which could be helpful to relieve other transportation networks (Baird, 1997). The dependence of ferry services on seaport infrastructure resembles the dependence of water taxis on available jetties, albeit on a different scale. In many European and international cities, ferry services used normal ports for decades. However, after the 1990's, the position of international ferry services in Europe began to decline as duty free sales between European ports were terminated and low-cost airlines began taking over (Poulsen, 2019). This development and the impact of the development is similar to the introduction of cross-Atlantic flights which impacted the Atlantic Ferry in the 1960's. For Nordic ferry shipping, it meant the passenger market decreased and they lacked resources to upgrade and improve their ferries. The globalization of trade also made it harder for ferry services to play a role in the regional business and the development of larger ferry services has therefore been very hard. The business for overnight ferry services in a large part of Europe has entered the declining stage of its life cycle (Poulsen, 2019).

Although the European situation seems worrying for the operators, there are still many different locations in the world where long-haul ferry services are viable and used on a daily basis to keep regions connected. These regions exist of multiple islands which depend on transport over water to stay connected with other regions. Inter-island networks are all relatively unique situations, even

though there are several different of these networks in the world. Effective island policies are therefore also complicated due to the particularity of island regions and the inability to apply a one-size-fits-all rule (Marta, George & Evangella, 2021). Examples can be found in Greece and the Caribbean, but most of these systems are found in Asian countries such as the Philippines and Indonesia. In the Philippines the ‘Strong Republic Nautical Highway System’, which is an cooperation between the governments road network improvements and increased efforts by roll-on roll-off (RoRo) ferry services to carry motors, cars, trucks and intercity buses (Figure 16), is competing with low-cost inter-islands airline services (Boquet, 2012).



Figure 16 Example of RoRo ferry in the Philippines (Newslines Philippines, 2017)

For the same inter-island situation in the Philippines, Diaz (2011) conducted a study based on a stated preference experiment and used a binary choice logit model to evaluate the impact of differences between air travel and sea travel. The most significant determinants of inter-island modal shares are fare levels, traveller income and trip purpose. Comparative fares between the modalities were of significant influence on mode choice. Trip purpose was also of influence on mode choice, with a ‘social visit’ trip being the most elastic and ‘work-related’ trips being the least elastic (Diaz, 2011). Boquet (2012) found that the most notable efforts made to facilitate the road/ferry system were upgrades on the network infrastructure and ports. Eventually, a reduction of 10 hours of travel times, a reduction of travel cost for goods by 30% and a reduction of travel cost for passengers by 40% were the most promising results for the road infrastructure and ferry services to become the most attractive option for the route chosen (Boquet, 2012). Research on the Canary Islands by Luis (2002) also mentioned the importance of the availability of inter-island ferry services during government and commercial working hours. In scarcely available European context, a discrete choice model study on the ferry to the Scilly Islands found low elasticities for day-trips and high elasticities for long-stay trips and residents, indicating staying visitors and residents may consider a wider range of travel alternatives (Kouwenhoven, Rohr, Miller & Daly, 2006).

The factors discussed in these studies, most notably trip cost, trip purpose and operating hours, are some of the factors contributing to the success of the ferry services. Although these studies are all focuses on inter-island services, the direct impact of these factors on the travellers’ choices have to be taken into account for local services as well. This includes possibilities to change operating hours and trip cost based on trip purpose, for example.

3.2.2 Ferry choice determinants

A comparative study of the ferry industry in Japan and the UK by Baird (1999) mentions differences between the international ferry services on which the UK relies and the mostly domestic services on which Japan relies. The Japanese ferries mostly relies on long-distance trucks which, instead of taking the sophisticated highway system, used ferries for domestic long-distance trips. This domestic 'sea highway' had positive influences on the congested highway system of Japan, but that is not something the UK was bothered with at the moment. Because of the Single European Market, the ferry services in the UK became arguably the most important means of transport between the UK and the European mainland, which is a different usage of the ferry services (Baird, 1999). However, after the UK left the Single European Market, the question is what is left of those benefits as there have been revisions to the reciprocal travel arrangements between the UK and EU.

The dependence of the UK and maritime and air transport to the European mainland can also be attributed to Ireland, which on itself is dependent on these types of transport to connect the country with the UK and the European mainland. RoRo ferry route choices between Ireland and continental Europe for the freight market noted some determinants of choice and additional important choice factors. The space availability for freight was the first of the determinants of choice, as well as the costs of the service. The important choice factors can be divided in three groups, namely time issues (arrival/departure times, speed, frequency), risk issues (cancellation or delay due to weather, technical reasons) and technical issues (ferry suitability for cargo, facilities for drivers). Some of the factors discussed in this study, which were not deemed determinants of choice, were the fastest overall route, potential for traffic delays at the port and several network determinants (Mangan, Lalwani & Gardner, 2002).

Both the international and domestic services in the comparative study of Baird (1999) offer an alternative to car or train networks. Most certainly, the domestic examples found in Japan are different from inter-island network situations which can be found in for example Greece and the Philippines. At the same time, ferry services can also function as gateway to more remote communities, which rely heavily on these services and value the operating day (to be of similar length as a working day) a most strategic factor to ensure economic and social prosperity for both passengers transport and freight transport (Laird, 2012).

However, although some of these studies (Baird, 1999; Mangan et al., 2002) dive deeper into different ferry services, the results are influenced by freight transportation more heavily than by passenger transportation. Baird (1999) linked the success of the Japanese sea highway with the amount of trucks choosing the ferry over the mainland highway system, Mangan et al. (2012) illustrated the important determinants of choice and choice factors of freight market towards the usage of ferry services. Laird (2012) mostly focused on the influence of a ferry service to function as gateway to remote communities, but focused on operating day as the most important factor.

All of these studies lack indications of the influence of either the target groups and their influence on the total passengers share, or the influence of choice factors on (potential) passengers of ferry services. Therefore, the studies mentioned only function as input to determine what factors can influence the choice for ferry services when compared to other transportation services. On long-haul freight transportation services, these determinants are based on the competition between ferry services and long-haul alternatives, such as air transport. In paragraph 3.3, the determinants for local alternatives have to be determined and can be compared with the determinants mentioned above.

3.2.3 Ferry services and target groups

In the comparative study of Japan and the UK, the demand in the UK was strictly international traffic, whereas Japan served domestic traffic. More notably, Japanese ferry services carry a quarter of all trucks travelling over long distances within Japan (Baird, 1999). This showcases the differences in target groups between the ferry services, albeit it in freight transportation. Research into the connection between tourism and a domestic ferry transport service between Wellington and Picton in New Zealand (Lohmann & Pearce, 2012) illustrated the importance of tourism and service dominance: In the capital city of Wellington, ferry services do not have a dominant position as the city's airport is the busiest transportation hub and offers the city international connections. In the relatively small city of Picton, ferry services have a major impact on the town and act as important link in the transportation system. On top of that, Picton is more influenced by seasonal disparities. Lohmann and Pearce (2012) conclude that 'the characteristics of places and their relative position in visitor circuits will play a significant role in the way in which and extent to which transport and tourism development are inter-linked'.

The availability of ferry services on islands is part of the destination competitiveness and has become a significant importance of business development and tourism growth (Polydoropoulou, Lagoudis & Tsirimpaa, 2012). In Greek context, demand for passenger ferry services shares characteristics with other island archipelagos around the globe, including difficulties to connect with the mainland, uneven dispersions of the population and seasonality of traffic involved. Case study by Polydoropoulou and colleagues (2012) on connections between the Greek mainland and the island of Chios found personal issues to be the main purpose for trips on two ferries between the mainland and island. Travel time, travel costs, the number of itineraries and the vessel type played important roles in ferry route selection, as well as the awareness of potential passengers on the availability of the connection. The awareness of potential passengers was crucial for the use of the ferry, with one of both ferries seemingly being known by fewer people.



Figure 17 Long-haul ferry service used between Piraeus and Chios (Blue Star Ferries, 2023)

Baird (2012) also reflected on travel time, travel costs and many other factors, but did not consider these from the point of view of the passengers, but on the point of view from the operators, comparing the efficiency of a private ferry service and a public ferry service in Scotland. The main differences between the operators were found in state subsidies, competition and the different transport policies. Whereas the private company was (of course) run with a business model in mind,

public operators run their operations based on different viewpoint and policies which can influence the delivery and management of remote island ferry services. This includes continually working on feedback and views from the communities the ferry serves, although some efforts of the government can create economic market distortions (Baird, 2012).

Research by Papaioannou and colleagues (2022) dived deeper into one particular contributing resource which influences the demand, which is the insights of potential passengers into the mixture of rate or cost, routing, schedule, reliability, equipment feature and flexibility. These factors can be combined in a Mobility as a Service (MaaS) platform to inform passengers about the service provided. Many of the ferry operators inform their passengers with applications. Examples are the apps from DFDS and P&O Freight. Considering inter-island ferry services in Greece, Papaioannou et al. (2022) concluded how crucial the accessibility of islands is for residents, tourists and the economic activities. Whereas in urban areas, public transport such as buses or trains are the basis for the MaaS platform, sea transport is part of the system backbone in the island regions in Greece. By making a 'Maritime MaaS', multiple transport modes can be integrated to improve accessibility to transport people on the islands, with the ultimate transition towards a 'holistic interregional MaaS plan for Greece' (Papaioannou et al., 2022).

In a research by Kizielewicz and colleagues (2017) the segmentation of demand for ferry travel for Stena Line in the Baltic Sea was studied. The Route between Gdynia in Poland and Karlskrona in Sweden carried more than 509.000 passengers on a long-haul service. The most important customer segments identified based on travel motives were 1) tourists, 2) visiting relatives and 3) business-/work-related travellers. Market share of tourists and business-/work related travellers was highest, both accounting for around 40% of the total market share. Almost 70% of the respondents in the study was male, whereas the dominant age was people between 24 and 44 years old. Gender and age group dominance was true for all three customer segments identified, with other demographical factors mentioned in the study being the educational level and additional customer segments identified with combination between motives (e.g. having both a tourism and visiting relatives' motive). Demographic features seem to remain stable over different travel motives (Kizielewicz et al., 2017)

3.2.4 Long-haul operator business operations

Besides academic literature, the business operations of the ferry service operators offer views into the core business and profit of the ferry operators, as well as reveal their interests and influencing factors on their success. DFDS, the largest ferry service operator in Europe and winner of the 'World's Leading Ferry Operator Award', was active in the North Sea, Mediterranean, Channel and Baltic Sea, with additional passenger lines between Newcastle and Amsterdam as well as between Oslo and Copenhagen (DFDS, 2023b). As a long-haul ferry operator, DFDS is both responsible for (overnight) ferry services for passengers as well as important ferry services for goods. In the annual report by DFDS, the company divided its main customer segments and mentioned that the North Sea and Mediterranean aim mostly at forwarders and hauliers. On the Channel, car passengers and coach operators are also of importance for the company. Only the two designated lines (Newcastle-Amsterdam and Oslo-Copenhagen) were aimed at passengers, with mini cruise passengers, car passengers and business conferences amongst the main customer segments, but which only contributed to 10% of the divisions' total revenue (DFDS, 2023a). This clearly shows the impact of passengers on the total business operations of long-haul operators can be quite limited when the operator focuses mostly on goods.

BC Ferries provides all major passengers and vehicle ferry services in the Canadian province of British Columbia. In their report over 2019 (pre-covid), the company corporate total profit decreased by more than 30% compared to 2018 as operating revenue decreased and operating expenses increased. However, the company still earned a lot, despite its relative losses compared to 2018 (BC Ferries, 2019). Asian based 2GO Travel reported a total of a combined Gross Registered Tonnage of approximately 126.695, total annual passenger capacity of approximately two million passengers and aggregate annual cargo capacity of approximately three hundred thousand twenty-foot equivalent units (TEUs) in the 2021 annual report. At the same time, the company stressed how their approach to travel was different than simply offering ferry services, as they can also provide customer with travel options, information and solutions before or after their ferry trip (2GO Group, 2021). These businesses seem to have found a good balance between passengers services and logistical services. Ferry operator Stena Line specifically segmented its demand for RoRo and RoPax ferries based on the activity, with freight taking 54% of the revenue, passengers bringing in 32% of the revenue and other activities (such as onboard sales) bringing in 14% of the revenue. This also clearly indicates the importance of freight for the long-haul ferry operators (Stena Line, 2018).

Bad examples in the ferry operator industry also exist, as ferry service operators can experience negative business effects and the declining stage of the life cycle of ferry services which might have arrived in several different places. Most notably, British operator P&O ferries fired over 800 employees as their work was taken over by cheaper replacements in order to reduce costs. This led to a lot of criticism, with several of the company vessels impounded, cross-channel ferry services mostly halted and even concerns on breaches of human rights in the process (Ewing, 2022). The saga of P&O Ferries, which is actually one of the oldest ferry operators, is an example of the negatives of corporate effects.

When concerning international academic literature reviews and business operation reviews of long-haul ferry service operators, several conclusions can be made. First and foremost, long-haul ferry operators exist in many different forms and sizes. As mode of transportation, it often provides regions or countries with an alternative to other modes of transportation. Because there is no one-size-fits-all solution for ferry services in different regions around the world, the services have mostly adjusted itself to fit the demands of the region it serves. Networks in the Philippines and Greece are examples of ferry services that have adjusted to the demands of the region and now function as low-cost inter-islands service as a competitor to low-cost airlines. Depending on the situation, there are certain determinants that influence passengers' choice for a ferry. The most common of determinants are travel costs, travel times as well as travel suitability. MaaS and other solutions such as lengthening operating hours are therefore important opportunities that can stimulate ferry usage. Looking at the target group and travel motives of passengers, there were some similarities between networks around the world. Tourism and visiting friends/family or other personal motives are more elastic and are an important part of ferry passengers market share. Depending on the region, business- and work-related travel is also an important part of the long-haul services.

These characteristics of long-haul ferry services should be considered carefully, although bearing in mind that a lot of the operators are mostly focused on freight and only have a limited focus on passengers and passenger demand. This is also the result of the fact that the operators are businesses and follow business plans to remain profitable organisations.

3.3 LOCAL NETWORKS

After considering long-haul service operators, the next step is considering local ferry service operators network. These local networks are focused on a particular city or urban area and offer alternatives to the urban transport networks, for example as an alternative to car trips, buses or metros. The focus on a local network fits the situation of Riveer in the river Merwede more, as their local network connects villages around the river. After considering (international) academic research on local ferry networks and possible examples of business operations reviews as well, comparisons can be drawn between the findings on long-haul services and local services, compiling the most important academic findings on ferries.

3.3.1 Characteristics of local ferry services

Examples of local ferry services are plenty throughout the world. Waxholmsbolaget in Stockholm, Istanbul Ferry Network in Istanbul, Sydney Ferries in Sydney, NYC Ferry and Staten Island Ferry in New York, GVB Ferries in Amsterdam, and Star Ferry in Hong Kong are some of the examples found throughout the world. All of these networks are unique on their own, as no archipelago or river delta is similar and the ferry network is dependent on the characteristics of the bodies of water it functions on.



Figure 18 Typical ferry by GVB in Amsterdam (GVB, 2023b)

At the same time, ferry services on a local network might be similar to long-haul networks: Some connect communities, other are more touristic routes and some might simply link important work-related locations. This is also dependent on the type of ferry network and the way the ferries are linked. Two examples of ferry networks and their different characteristics are the ferry network in Amsterdam and in Stockholm: The ferries from GVB in Amsterdam make up a network of fixed, single destination lines (GVB, 2023a) similar to the Riveer network in the river Merwede around the Merwedebrug. The fleet of 13 ferries of GVB on the IJ river connects the region of Amsterdam North to the city centre. This area of Amsterdam lacks possibilities for pedestrians and cyclists to reach the other side of the river, as the only fixed link in the centre is a tunnel in which pedestrians and cyclists are not allowed. The first accessible fixed link over the river are at least 5 kilometres away from the city centre, which makes crossing the river difficult. The RoRo ferries of GVB, one of which can be seen in Figure 18, are therefore aimed at taking pedestrians and cyclists across the river and do so for free (GVB, 2023a). The network within Amsterdam is therefore quite limited, as there are only few connections, but the connections are free of costs for passengers and because of the limited number of stops, ferries can leave every couple of minutes.

In Stockholm, the ferry network functions the same, but at the same time completely different. Because of the characteristics of the archipelago of Stockholm, which has over 24.000 islands, the largest ferry services provided are not aimed at directly connecting the city centre with other urban areas, but rather also to connect the metropolitan area and make a directly accessible public transport service for communities further away from the Stockholm city centre. The operator Waxholmsbolaget therefore connects over 300 destinations in the metropolitan area, spread along 150 kilometres of coast of the Stockholm County (Waxholmsbolaget, 2021). The ferry network map for Waxholmsbolaget services, which can be seen in Figure 19, resembles a metro-like network.

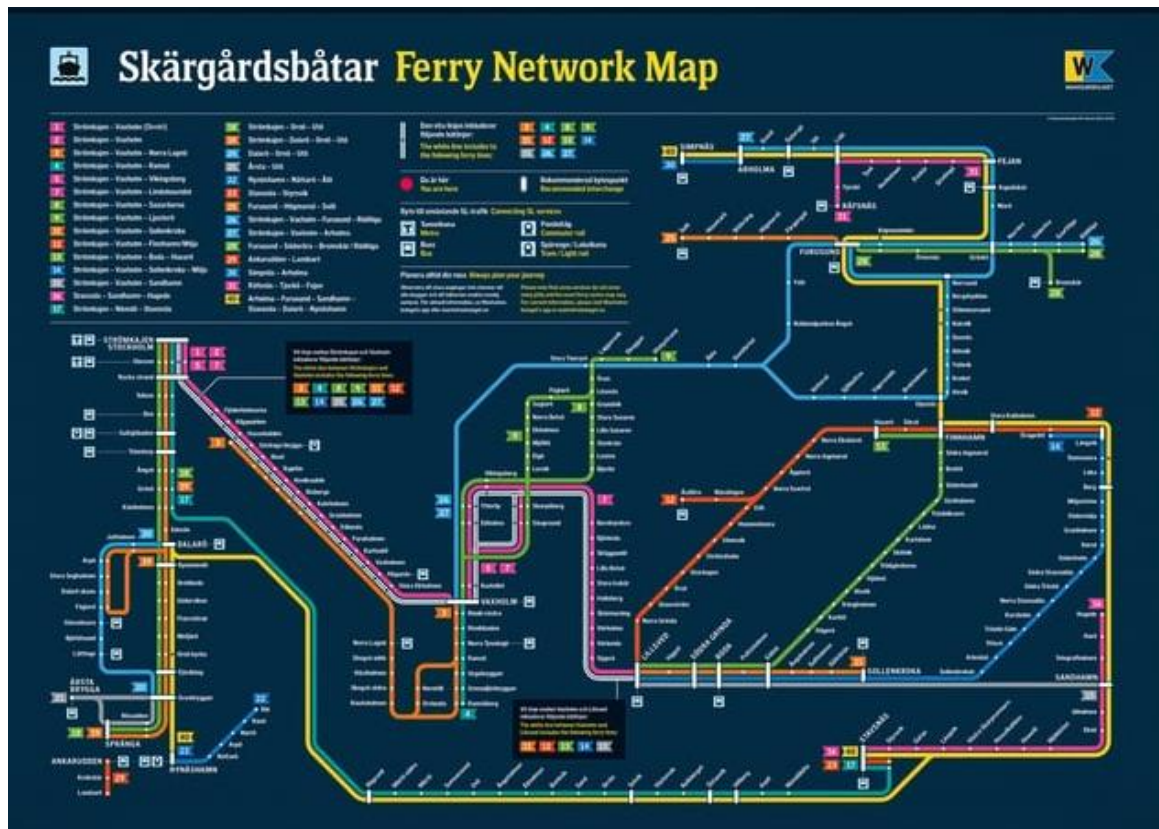


Figure 19 Ferry network map from the Stockholm archipelago (Waxholmsbolaget, 2021)

At the same time there are additional ferry lines within the Stockholm city centre run by the transport operator SL. SL operates trams and light rails in the Swedish capital and also runs four ferry lines connecting areas within Stockholm (SL, 2023). These lines more or less resemble the lines run by GVB in Amsterdam, although the lines by SL have more destinations on a single line and do not run between only two destinations. The scale of the services does however resemble Amsterdam.

The two examples are probably the most common of local networks, one either connecting areas within a city and being focused on inner-city traffic, whilst the other spans a much larger area and is aimed at connecting metropolitan areas. All of these local networks function with ferries for pedestrians and cyclists. The cases for Amsterdam and Stockholm are examples to which will be referenced back during the next paragraph as well. Academic literature on other situations around the world will be used to further study the impact of local ferry services and the possible target groups, possibilities and difficulties of these networks.

3.3.2 Ferry service development

In the context of developing countries, ferry transport was first and foremost an important element of economic development because of their ‘fundamental reliance on ferries for the transport of people and good’, which made ferries important for jobs and trade (Weisbrod & Lawson, 2003). This also influenced the target groups, which were mostly passengers who used the ferries to get to their jobs or who used the ferry to reach markets and other places of economic value. In Europe and North America, the ferry was one of the safest forms of transportation. However, in the early 2000s’ the safety of ferry services in developing countries was a real concern and maritime disasters were relatively common (Lawson & Weisbrod, 2005). By 2023, safety concerns on ferry transport in developing countries was still relevant (Hebbar, Yildiz, Kahlouche & Schröder-Hinrichs, 2023) and the international community is still continuously seeking to enhance safety in the domestic ferry industry. This can concern ferry services in archipelagos such as Indonesia and the Philippines, but also river deltaic systems (Bangladesh), extensive riverine systems (DRC & Nigeria) or a combination of these (Tanzania). These high-risk countries and their view on safety of ferry services differ greatly from for example the European and North American views (Hebbar et al., 2023). This also impacts availability of research on these services, as these relatively poorly developed services lack registration, certification and hardly gather statistics.

There is more than enough research to support the idea that ferries can be part of the urban transportation system. Jorgensen and colleagues (2011) found that Norwegian ferry operations stimulate annual welfare generation and contribute with social surplus. Studies in south east Asia (Utomo & Mateo-Babiano, 2015) on inland water transport modes (IWTs) concluded that ITWS’s can be a crucial component in developing an ‘integrated, sustainable transport system in cities in developing Southeast Asia’. This does however also bring a lack of academic literature to light, as we are still learning to recognize the existence of these networks and modes of transportation as well as strengthen our understanding of how these ITWs function as important connection for local communities. Local powers and cultural diversity play in important role in developing countries and ITWs almost always are still are a form of informal transport (Utomo & Mateo-Babiano, 2015). Therefore, the ferry services and similar forms of transport are still an exciting opportunity for developing countries.

In general, water transit and ferry systems in particular are becoming an increasingly popular transport option worldwide. Ferries are an interesting form of transport as their routes configuration, high speed, high capacity addition to an existing public transport system makes them stand out (Tanko & Burke, 2016). This immediately also explains how the urban linear routes of ferries are different from the long-haul variants. Analysis of seven existing ferry systems around the world and their development found that there were a number of reasons for ferry systems to develop. Besides the core business of moving people around, the key actors involved in the planning and operation of the systems also involved economic development, tourism and city branding (Tanko & Burke, 2016). The transport innovation of the urban linear ferry systems is therefore much more than a simple expansion of urban transport possibilities. In a comparison between the cases of Gothenburg and Stockholm in Sweden and Brisbane and Sydney in Australia, water transport only provided a minimal share in the total public transport network. However, the Australian cities are now focusing on waterfront and transit plan focused on economic development, creating new opportunities for ferry services in these cities. These types of ferry-oriented development (FOD) are harder in Gothenburg and especially Sweden, where the integration between land use and FOD is not as apparent as in Australia (Tanko, Burke & Cheemakurthy, 2018).

The implementation of FOD was also a point of concern in other countries. Camay and colleague (2012) described the changes in New York City's waterfront zoning and land use, which did not include any efforts to implement ferry systems into new developments. A robust passenger ferry system can only prosper in the city if new developments on the waterfront take an integrated look of the services on the waterways and include transit planning into the economic development process (Carnay et al., 2012).

On the other hand, there are several cities around the world which have seen transit oriented developments (TOD) on other services rather than the ferry. Most notably, the ferry was the most important mode of transportation in Hong Kong up until roughly the 1970s, after which redistribution of the population and the enlargement of new bridges, highways and tunnels changed travel patterns (Lau, Tam & Ng, 2022). This meant water-divided cities started to connect island or shores either by land reclamation or by building fixed links in the infrastructure. Therefore, ferries have become a complementary form of transportation on top of other infrastructure network and function more as a niche rather than as a form of mass-transit. Ferries still also play an important role when other transportation networks are fully occupied or when any other disruptions are felt. Ferries can cater to special demands and can help during disruptions on mass transit railways or during road closures (Lau et al., 2022). This is an important consideration as the temporary function of a ferry as a relieve service for other forms of transportation is similar to the situation caused by the road closure on the A27 in the case study.



Figure 20 4th Generation Star Ferry in Hong Kong (Star Ferry, 2023)

Most Hongkongers think the ferry is an essential service for the city and contributes to economic development, fostering tourism development and pertain social identity. However, with tourism stimulating ferry networks' expansion as most important target group in Hong, the question is whether local residents will keep profiting from expanded networks during off-season or off-peak hour times (Lau et al., 2022). Of course, this development goes hand in hand with local tourism, as the Covid-19 pandemic grinded international tourism to a halt but made significant differences in the stimulation of local tourism as well (Lee & Leung, 2022). Increasing search frequencies for outlying islands and outdoor recreation indicate how local tourism thrived and ferries were an important part of the tourism route services.

Ferry service developments differ between cities in the world, but in general were and are an increasingly popular transport option. The possibility of using this alternative mode of transport to reach activities within a city is useful both for locals, as well as for touristic activities. The ferry can function as an alternative for other modes of transportation in the first place, but moreover also thrives when the main modes of transportation face problems. Expansion of networks are however difficult as most cities aim at improving other networks before ferries. FOD should make it possible to stimulate both land-use and ferry networks simultaneously.

3.3.3 Service network and target groups

Academic research on ferry service network designs is more often aimed at using modal or network flow problems like in any other transportation network. Lai and Lo (2004) for example used a mixed integer multiple origin–destination network flow problem with ferry constraints in terms of capacity to come to optimal fleet-sizes, routing and schedules for the transportation network. Their mathematical model uses algorithms and polynomial-time performance, using two scenarios in Hong Kong to demonstrate the model. One other very particular type of research into routing and scheduling problems address service network design problems (SNDP) which is a model which determines service network and passenger flows simultaneously. This mathematical problem determines passenger service choices and is used to formulate a routing and scheduling model (Wang & Lo, 2008). However, these models can only base their results on presumptions of the human factors involved in this model and are therefore dependent on the opinions and feelings of passengers, which are often generalized to produce results. Although useful for network modelling, this study seeks to determine these opinions and feeling of target groups whilst using more segregated groups.

In Hong Kong, FOD was a very difficult development as the focus of the government was not the ferry, but other forms of transport. The battle of the ferry, which in the first place had a poor level-of-service, with new roads, bridges and tunnels created for other forms of transportation was almost lost before it had even begun (Ceder, 2006). To make the best use of the water in Hong Kong, Ceder (2006) created a multi-objective evaluation method in order to assess the ferry routes with scientific, practical, and simplified analyses. Once again, a tool used to assess ferry routes or network. The proposed design and ferry routes can have positive impacts on the ferry systems' image if used correctly. It therefore seems as if the viability of ferry networks both in long-haul shipping (see last paragraph) as in local network is mostly determined based on mathematical and practical models to determine viable routes and fleet which eventually determines the service provided.

On the other hand, ferries in local context are known to be used for many different reasons. In Hong Kong, ferries allow the residents of the city to live, shop, work, go to school and enjoy recreation in other regions of the city (Lau et al., 2022). On the other side of the world, in New York, the Staten Island Ferry annually services over 22 million people free of charge, with the majority of activity during rush hours on weekdays (Staten Island Ferry, 2023). This indicates the ferry is also used as inner-city mode of transportation for residents going to work, as well as a mode of transportation for tourists in the city.

Estimations for the number of passengers with different travel motives and thus the division of the total number of passengers between different target groups of ferry service users in local networks was not found in any academic literature. In the case study of Hong Kong and other cities mentioned earlier in this chapter, some of the information on the target groups could be derived from the focus of the research and the development of network systems towards places of economic interest directly linked with new residential areas or tourism. Particular academic research on target group for

ferry services in cities is scarce. A particular research on travel patterns of passengers on the ferry system in Brisbane did indicate ferries are used by city commuters as the number of trip transactions observed during weekdays and rush hours in particular increased significantly (Soltani, Tanko, Burke & Farid, 2016). Only less than 15% of the trips incorporated ferry trips with a transfer to other public transport modes such as buses or rail. The frequency of use showed the majority of ferry users being occasional users with a low travel frequency, although the majority of trips was made by the high frequency users. According to Soltani and colleagues (2016), this indicates ‘that the ferries are therefore used by a much wider cohort of the Brisbane community than previously imagined’.



Figure 21 New York City Ferry network map (New York City Ferry, 2023)

Besides the academic literature, ferry service operators around the world were analysed and any passenger information was gathered to create a general image on the usage of the ferry services. New York City Ferry (a different operator than New York City Department of Transportation which runs the Staten Island Ferry; Figure 21) conducts surveys amongst passengers on different ferry routes in their network. In their (pre-Covid) summer of 2018 survey result summary the number of commuters on the ferry was found to be 34% of all passengers (New York City Ferry, 2018). During peak periods, this number increases to 71% of the riders. On top of that, 89% of the riders are New Yorkers, which indicate that ferry usage for (inter)national tourism is maximum 11% and thus relatively low. It also indicates that the ferry is often used to travel for other motives, such as visiting friends, family, going to shops or visiting healthcare. 62% of passengers walk to the jetty to start their journey on the ferry, indicating a lot of local residents with limited trip lengths use the ferry (New York City Ferry, 2018). Although hardly comparable with the statistics from Brisbane, these numbers do paint a picture of ferry usage in both cities.

3.3.4 Temporary ferry services

In academic literature, the function of ferry services as a temporary measure of relief is scarcely documented. Lau and colleagues (2022) were the only to report the opportunity to use ferry services as alternative during problems with other modes of transportation, but only did so as to highlight potentials for the ferry. The only services which were found to support the idea of temporary ferry services, were services deployed by RWS in the Netherlands on earlier projects. In a case study of RWS at the Velser Tunnel, the deployment of a ferry was used as temporary service on the North Sea Canal. This was back in 2016 when the tunnel closed for nine months and alternatives had to be found for the traffic which would normally use the tunnel (Rijkswaterstaat, 2017). A combination between an extra rush-hour ferry and cycling incentives led many cyclists to use the ferry instead of making a detour through another tunnel in the region. At the same time, the ferry could also continue sailing for longer hours if any problems on the main road network occurred which would lead to more cyclists taking the ferry. Whereas normally around 4.000 passengers per day would use the ferry, this number increased by 40% during the period of closure of the Velser Tunnel. However, RWS does mention that the tunnel was completely closed for all traffic and the distances in the IJmond are easily covered by bicycle (Rijkswaterstaat, 2017).



Figure 22 RWS deployment of ferry at the Velser Tunnel (Rijkswaterstaat, 2017)

Similar initiatives are implemented occasionally throughout the Netherlands, not only by RWS but also by municipalities or other operators such as ProRail (ProRail, 2022). These ferries are aimed at taking pedestrians and cyclists across a relatively small body of water, providing direct accessibility between regions that become more remotely accessible as the result of a project on a bridge or tunnel, resembling the situation around the Merwedebrug. According to RWS, a ferry normally does not attract many new cyclists or public transport users, but rather reduces the barriers. In very specific cases, with enough other incentives, a ferry may contribute to a modal shift however. Other important factors that can contribute to the success of a ferry are the frequency of the ferry service, the context in which the ferry service is implemented (length of detours, congestion in the region) and the accessibility of other modes of transport. Preferably, the boats moor within minutes walking of metro, tram, bus and/or train stations (Rijkswaterstaat, 2017).

The success of a temporary ferry service is therefore not solely dependent on the ferry itself, but rather also on the situation the ferry service is deployed in. In earlier cases by RWS, ferries deployed in urban areas were an extension of already available services and were complemented with other incentives, mostly related to cycling.

3.4 CONCLUSION

The aim of chapter 3 was answering the research question: What are the possibilities of (temporary) travel over water, what has proven successful around the world and what conditions should travel over water fulfil? To answer this question, we look at the ferry services academic literature and the services provided throughout the world. On one side, there are long-haul services between cities, countries and continents, whereas on the other hand there are local ferry services and water taxis within a region or urban area.

Long-haul ferry services were once a dominant mode of transportation over long distances, but has shifted more towards inter-island networks of which there are many examples around the world. The RoRo ferries service cars, trucks and sometimes even buses. Significant determinants for these services include the fare level, traveller income and trip purpose. On top of that, the travel times and the hours during which the ferry services are available are also important parts of the travellers' choice. This last factor is most notable on ferry service to remote communities, which rely on ferries for both the economic and social prosperity of the community. However, the service provided by long-haul ferries is generally influenced heavily by the importance of freight on the services. Target groups for many long-haul services consists of trucks or include connections with freight operators. When it comes to long-haul services which are more aimed at tourism or connecting communities, there is no one-size-fits-all. An example from the Baltic Sea found tourism, visiting relatives and business-/work related trips the most important travel motives. Depending on the dominance of the ferry service and the importance of tourism, transport and tourism development can be inter-linked. For these routes, important factors still remain travel time and travel costs, as well as the number of itineraries and the vessel type. Another important factor is the awareness of passengers on the existence of the ferry. Maritime MaaS can be important for this awareness.

Local ferry services are mostly located within cities, where networks have been created to connect parts of the urban area split by a body of water. Networks around the world use ferries for pedestrians and cyclists to offer alternatives to the car or other modes of public transportation. Services around the world differ, based on the characteristics of the region. In Hong Kong, ferries allow residents to live, shop, work, go to school and enjoy recreation. In New York, ferries are used as inner-city modes of transportation for both residents going to work as well as tourists. A survey in New York showed 34% of passengers were commuters, 89% were local residents and 62% walked to the jetty before their trip. Again, there is no one-size-fits-all, as networks can be used for inner-city traffic or can even connect the entire metropolitan region. In relevant literature, ferry services prove to stimulate annual welfare generation and contribute with social surplus. In developing countries, which still face safety concerns over transport over water, ferries can be used as integrated, sustainable mode of transport because ferries provide high speed, high capacity additions to the public transport network. FOD on waterfront zoning and land use can provide a city with new travel opportunities when other networks are fully occupied or disrupted. Examples of this have been implemented in the Netherlands, where temporary extensions to existing services helped pedestrians and (mostly) cyclists during periods of hindrance in urban areas.

Ferry services are different throughout the world, but factors such as trip cost, time, fares and trip purpose influence all services. Temporary services are rare, but local ferry services are already used as an alternative to other existing modes of transportation, which is exactly what temporary services will provide.

4. Identifying Potential Passengers

4.1 TARGET GROUP RESEARCH

The goal of this research is to understand how and for whom travel over water can be an alternative during periods of hindrance. During the observations, interview and literature research, information has been gathered to understand the case study around the A27 and understand how travel over water could be used in a mobility system or even as part of a temporary solution. The information from the observations, interview and literature can also be used to set-up target group research and helps to formulate questions which are explicitly aimed at certain important factors, demographic or socioeconomic features or behaviours that can influence the success of travel over water. The question which will eventually be answered is: What target groups can be identified for whom travel over water during these periods can be a realistic and relevant alternative and how should these target groups be approached to optimize the effect of this alternative?

4.1.1 Survey and target audience

To identify target groups, a methodology has to be chosen in which a segmentation can be made over the population which is affected by the problem. Target group research is essentially finding out what type of target audience your product or service is interesting for. Collecting data and analysing that data to distinguish target groups based on demographic, socioeconomic, behavioural or other factors is essential in this research. Although some data on the segmentation of demand already exists (Kizielewicz, 2017; New York City Ferry, 2018), this data cannot be used to answer the research question in this context as this data was gathered in different demographic and socioeconomic locations based on structural ferry services and in one case based on a long-haul service.

As mentioned in the introduction, the case study on the A27 is solely one of many projects which will take place over the next decades on Dutch bridges, tunnels and other parts of infrastructure. Studies on the possibility to include a ferry as a mobility management measure should therefore be made as generically as possible in order to make sure the conclusions drawn and recommendations made can also be used on other locations during different projects. This was emphasized by the project team of BMN and RWS, although both also prefer recommendations on the specific case study of the A27. In academic literature, there was support for the fact that travel over water is very location specific and there is no one-size-fits-all approach (Marta, George & Evangella, 2021).

In order to gather data in the context of the reconstruction projects the Netherlands is facing and the possibility to include ferries as a temporal mobility management measure, data will be gathered using a survey. The target audience for this survey will be all Dutch inhabitants which can participate in traffic, which has been set to every inhabitant of the Netherlands as every inhabitant in the Netherlands will face the problems of the reconstruction projects in their own way and can use the ferry as an alternative. In the ODIN reports, children below 6 years old are not taken into consideration as their participation in traffic is dependent on their parents or other adults (CBS, 2022). As it is unclear how large the population above 6 years old is, the population taken into account for the survey will be the entire population of the Netherlands.

4.2 SURVEY SET-UP AND QUESTIONS

The survey through which the target groups for the ferry will be determined will consist of different categories. The foundation of basic data for any respondent will consist of demographic and socio-economic features, which is the first category. Demographic and socioeconomic data will make it possible to divide the total number of respondents into different groups and will determine if the sample is a representative sample of the target population for generalization. The second category of questions will be related to behaviour and psychographic features. These questions will dive deeper into the subject of the survey which is transportation over water. The sampling method used is simple random sampling as every member of the population has an equal chance of being selected. The two categories will be separated in the survey. Firstly, the most content-related questions on psychographic features and behaviour will be asked, after which the survey ends with demographic and socioeconomic questions. As in any survey, respondents are most likely to drop out of a survey later on, during the most difficult questions. By starting with the content-related questions, the end will consist of relatively easy demographic and socioeconomic questions which should optimize the completion rate of the survey. The survey is started with an introduction page, on which the context of the research and the goal of the survey are explained. Respondents are guaranteed that their answers are completely anonymous, are given an expected time of completion for the survey and are explained participating is voluntary. On top of that, contact information is given to respondents in case of any questions and respondents are thanked for your participation. After completion, respondents are thanked again for their cooperation and can submit their answers. The set-up of the questions is explained in detail below, the survey can be found in Appendix 4.

4.2.1 Behavioural factors

As travel over water can be done in many different ways, the survey starts with a short explanation of the context in which this research takes place. Because the situation around the Merwedebrug, but likely also for other situation where bridges or tunnels cause hindrance, asks for a local solution and the network only spans several lines, the most common use of travel over water around the world as experienced in paragraph 3.3. is a ferry for pedestrians and cyclists. Not unsurprisingly, this is the type of ferry already in use by the company of Riveer around the Merwedebrug and therefore this type of transport over water is the type of transport the survey will focus on. Respondents are told the survey focuses on a ferry used as a local means of transport, for example to connect two villages or urban areas on either side of a river.

Travel over water is not a common means of transport in the Netherlands or even around the world. In the national data on transportation ODiN, travel over water as a whole is not even mentioned as a mode of transportation (CBS, 2022). This resembles situations around the world, as travel over water is dependent on the possibilities provided by bodies of water and are hardly deployable on large scales. As travel over water is not as common as other modes of transportation, it is important to understand how the population thinks about a ferry in general. The first questions are therefore aimed at understanding current behaviour and opinions of respondents on using a ferry in general, independently from the use of a ferry during temporary situations. As starting question, the respondents are asked about their opinions of using a ferry in general. By also asking whether respondents have used or often use a ferry at the moment, the current behaviour is examined, as well as making it possible to examine whether common users have positive or negative associations with the ferry. Thirdly, because trip purpose plays such an important role in ferry usage (Kizielewicz et al., 2017; New York City Ferry, 2018) the opinion about using a ferry with different trip purposes is also asked to respondents, with trip purposes based on segmentations by mentioned studies and ODiN.

After these questions regarding the general opinion of the respondents on using a ferry as a mode of transportation, the questions are aimed at using a ferry during periods of hindrance caused by construction. Before these questions are introduced, the respondents are directed to a new subpage to attract their attention to this renewed page. In the introductory text on the page, respondents are asked to place themselves into the situation in which a bridge or tunnel on their route has been closed and a ferry is the alternative. The parameters for this closure are based on the situation around the Merwedebrug:

- Based on the estimations of RWS and BMN from the interviews and the estimated times detours would take from paragraph 2.6, the travel time would be reduced by around 20 minutes. Although travel times in the direct area around the Merwedebrug for example can be shortened by more than 30 or even 40 minutes, the average time it would take passengers to board the ferry and travel over water limits the time won over taking a detour by car to around 20 minutes.
- Based on the indications of RWS and BMN that public transport cannot be seen as an alternative in this region, the possibilities to travel by ferry are limited to pedestrians, cyclists and people choosing to leave their car near a jetty to travel the last part of the journey by ferry. If there were to be any multimodality, perhaps through a MaaS system, there would be a need for integrated and seamless mobility (Papaioannou et al., 2022). This is not the case, so the possibilities for the passengers are limited to either pedestrians, cyclists or car passengers who choose the ferry as last part of their journey.

The questions for respondents after this introduction are aimed at determining whether or not a ferry would be used during the temporary closure of bridges and tunnels and for what trip purpose they would use the ferry. These trip purposes are similar to those on the pretemporal question. Besides trip purpose, the respondents are also asked about the motivation for their choices. The most common choices to choose the ferry derived from literature in chapter 3 are travel times and travel costs, as well as the suitability of the ferry. The respondents are asked if they would use the ferry because the travel time is lower, but are also asked if they would use the ferry if it would bring them within walking distance from their destination or if the ferry is free of costs. Of course, respondents also have the possibility to make suggestions or choose not to use a ferry under any circumstances.

4.2.2 Demographical and socioeconomic factors

After looking at the behaviour and psychographic features, the demographics and socioeconomic circumstances of the groups are taken into consideration further. These features are not looked at for the entire population, but are used to determine whether particular target groups which oppose or support travelling by water have specific demographic or socioeconomic features, or the other way around. Firstly, the two demographical features age and gender are determined. These two features are also used as features in ODIN (CBS, 2022). The age groups are children (17 years old or younger), young adults (18-24 years old), adults (25-64 years old) and elderly (65 years old or older). The first socioeconomic feature also resembles ODIN, as respondents are asked about their occupation, with differences between an employee, student and other occupations. These occupations are closely related to trip purposes and might explain trip purpose travel opportunities. Therefore, this question is one of the questions that might make it possible to create target group sublevels which can be compared with each other. Cross-analysis of target group using demographic and socioeconomic features to divide the population and compare subgroups is further elaborated on in chapter 5.

The last socioeconomic questions are the result of the observations made and remarks heard during these observations. The first of those questions is the result of the remark of a company during the observations about the inopportunity of their employee to use an alternative mode of transport as their employees are bound to a vehicle. Therefore, all respondents who indicate that they are currently employed are asked about a possible tie to a company vehicle. On top of that, BMN actively supports travelling differently or not travelling at all, which is also one of the opportunities for employees and even students. Respondents are asked about their ‘normal’ travel patterns in the last three questions, which can help indicate what target groups travel to work more often and what target groups travel by car often. This helps indicate what target groups have a relatively large impact and where opportunities to offer travel over water as an alternative might be greatest.

4.2.3 Survey sample size and result statistics

When a survey is conducted the sample size needed is dependent on different factors. The sample size can be calculated using a formula in which population, confidence level and margin of error play a role. In the first place, the population affected by the problem or subject treated on the survey is a factor. The population of the survey conducted for this research was over 17,8 million inhabitants as this is the registered number of inhabitants of the Netherlands by late March 2023 (CBS, 2023). The population is an important factor in the formula, but when the population exceeds 20.000, the sample size will remain relatively stable. Therefore, an estimation of 17,8 inhabitants was used as vantage point for the formula. As this population was known, the confidence interval and margin of error, also known as confidence interval, had to be determined to create a sample size. In this case, both were predetermined based on the typically used levels. This means that a confidence level of 95% was used with a margin of error of 5% (Bishara & Hittner, 2016). This eventually means a sample of 385 respondents had to be reached to reach a confidence level of 95% and margin of error of 5%.

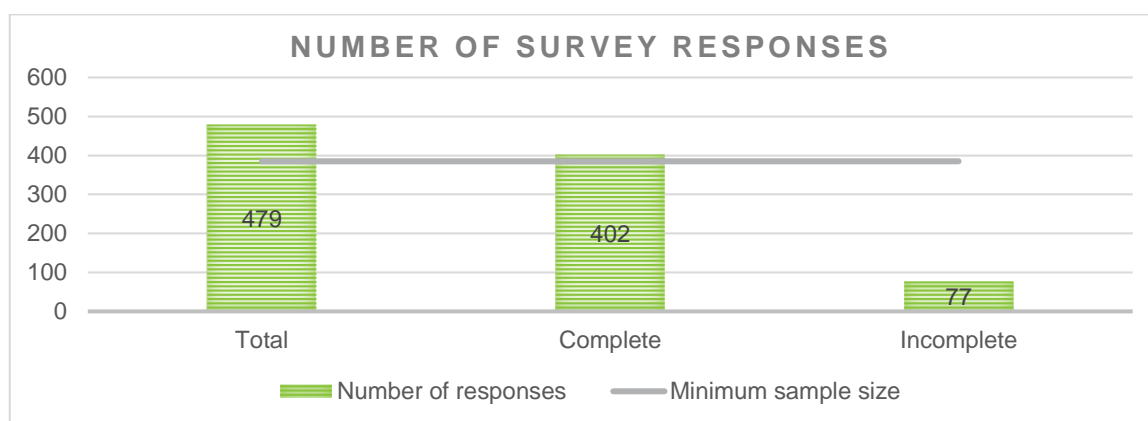


Figure 23 Number of survey responses

Results for the survey were gathered through the survey programme Survio, an online tool which was acquired by the license of XTNT. The survey was available for all respondents between April 18th 2023 and May 2nd 2023. Due to the population being Dutch, the survey was conducted in Dutch and translated to English in Appendix 4. The total number of visitors of the survey was 479 of which 402 have completed the survey and are considered respondents of the survey. This means the percentage of successful visits to the survey is 83,9% when considering the number of respondents compared to the total number of visits. With a total of 402 respondents, the sample size of 385 respondents has been reached and the results comply with a confidence interval of 95% with a margin of error of 5%.

4.3 SURVEY RESULT DIRECT DATA ANALYSIS

Based on the opinions of all 402 respondents a general view of the survey results can be created. This is useful to create an overarching image of the attitude, behaviour, motives and other features which are part of the survey. The overarching direct data results are discussed in this paragraph. In chapter 5, in-depth survey result analysis and cross-section analysis will further elaborate on these results. Because the survey required respondents to fill in all questions before answers could be submitted, the incomplete surveys are not taken into consideration at all in the data results. The data results used for analysis are only results from completed surveys.

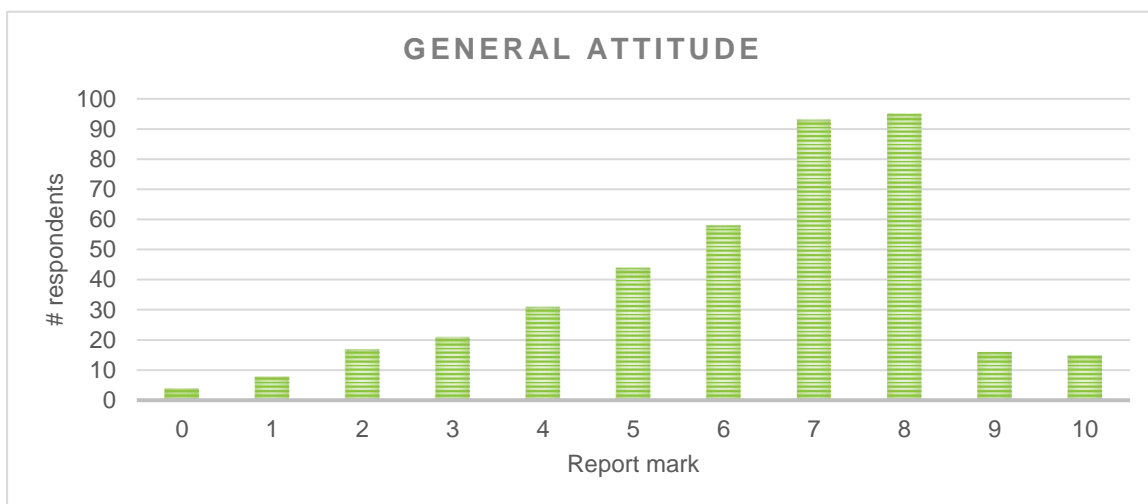


Figure 24 General attitude on ferry usage (n=402)

Looking at the general attitude of the respondents towards using a ferry, the majority of respondents react positively. With an average of 6,2 and the report mark 8 being the mode within the set of data values, the respondents are generally positive towards using a ferry. The report mark 7 and 8 combined have a total of 46,7% of the total responses and are by far the most common data values in this data set. Only 31% of respondents think of the ferry negatively and have rated their general attitude towards using the ferry with report mark 5 or lower. However, looking at the number of times the ferries is actually used by respondents, it can be concluded that there are only few frequent ferry users within the sample size.

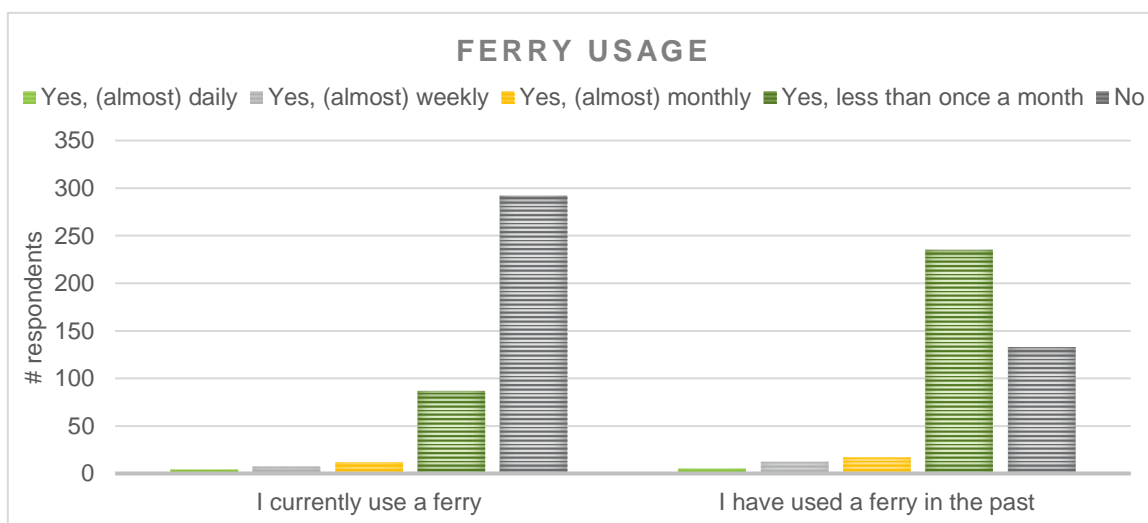


Figure 25 Current and past ferry usage (n=402)

Ferry usage not being very common amongst the respondents is no surprise based on the ODiN reports which do not even include travel over water as mode of transportation amongst the most used modes which are analysed in the reports. The data in the survey seems to support this idea, as nearly 73% of the respondents do not use a ferry as a mode of transportation in their current trips, with another 22% of respondents using a ferry less than once per month. Only a couple of respondents are more frequent users. This is also true for ferry use in the past. Only around 8% of the respondents have used a ferry more frequent than once per month in the past. The majority of 58% has used a ferry in the past, but only sporadic. Surprisingly enough, although the Netherlands is filled with bodies of water, 33% of respondents have never used a ferry.

Looking at the number of times respondents use or have used a ferry, it can be determined whether being familiar with ferry usage might influence the attitude of respondents. For all respondents who use a ferry more often than once per month, the mean attitude towards using a ferry is higher (7,26) than that of those who have done so once per month or less or never uses the ferry (6,16).

This is also true for group of respondents which has used a ferry more often than once per month in the past (7,23) when compared to the group who used the ferry once per month or less or has not even used the ferry in the past (6,13). Moreover, respondents indicating they have never used a ferry also rated their attitude towards ferry usage lowest with mean attitude of 5,08. This indicates that those who have experienced ferry usage tend to like travelling with this mode of transportation more than those who are unfamiliar with ferries or ferry usage.

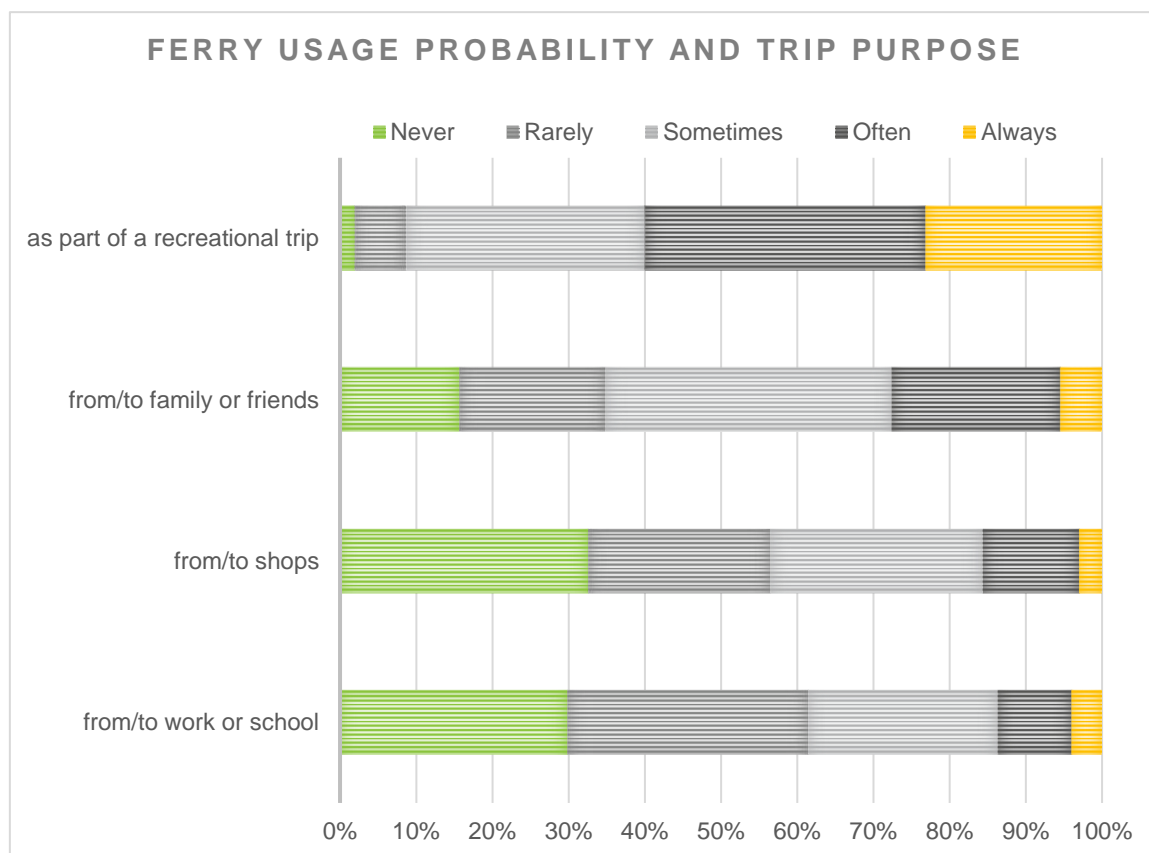


Figure 26 Ferry usage probabilities and trip purpose (n=402)

When asked about the usage of a ferry for different trip purposes, the general attitude of the respondents differs per motive. Using a ferry as part of a recreational trip is the trip purpose which is deemed the most suiting. A total of almost 60% of respondents would often or always use a ferry as part of a recreational trip, whereas only 8,7% oppose to the idea. This is different for other trip purposes. For a trip to family or friends, almost as many people support the idea (27,6%) as oppose the idea (34,8%). A majority chose 'sometimes' as preferred option. Both trips to school/work and trips to shops have had more negative responses. Almost 30% of respondents think a ferry is no mode of transportation which can be used for a trip to work or school, with another 30% of respondents saying they would rarely use a ferry for these trips. Only 14% of respondents would often or always use the ferry for this trip purpose. This closely resembles the responses on using the ferry for a trip to shops, with even more than 30% of people saying they would never use the ferry and a total of only 16% saying they would often or always use the ferry.

These simple statistics show how using a ferry for recreational trips is looked upon the most positively, with trips to family or friends as a second best and both other two as least favourite. Of course, as the number of trips made for every trip purpose is not taken into consideration in this question, this does not mean it is possible to simply draw conclusions based on this single opinion of respondents. However, it does provide an overarching view on the attitude of respondents towards using the ferry for different trip purposes and this will be useful to conduct further cross-section analysis later.

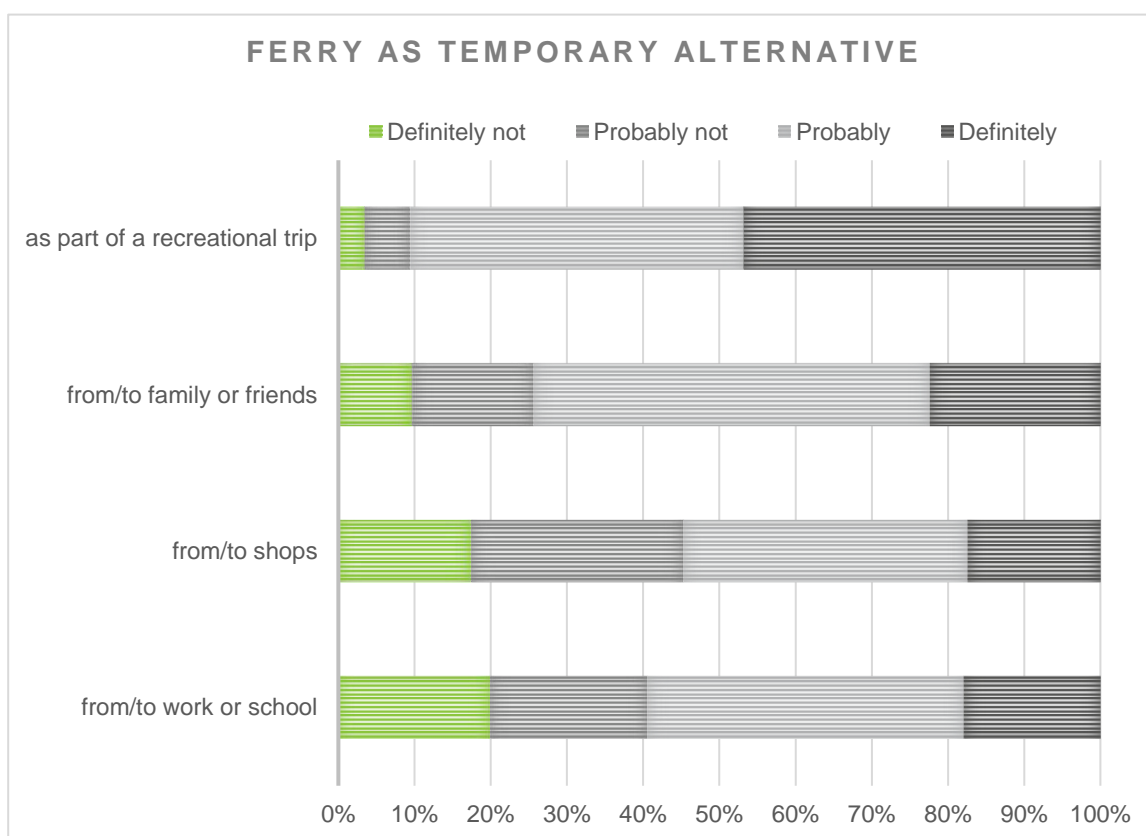


Figure 27 Ferry as temporary alternative (n=402)

The follow-up question on the trip purpose question is asked after the explanation of the temporary situation the ferry can be used in. Once again, the respondents are asked to answer this question for different trip purposes similar to those in the previous question.

More than 90% of respondents would use the ferry as an alternative mode of transportation for a trip which has a recreational purpose. Almost 75% would use a ferry as alternative for a trips to family and friends. Once again, the probability of ferry usage decreases for trips to shops, work or school, although the majority remains positive to use the ferry as an alternative for their journey. For both of these trip purposes, less than 20% would strongly oppose to using the ferry as a means of transportation.

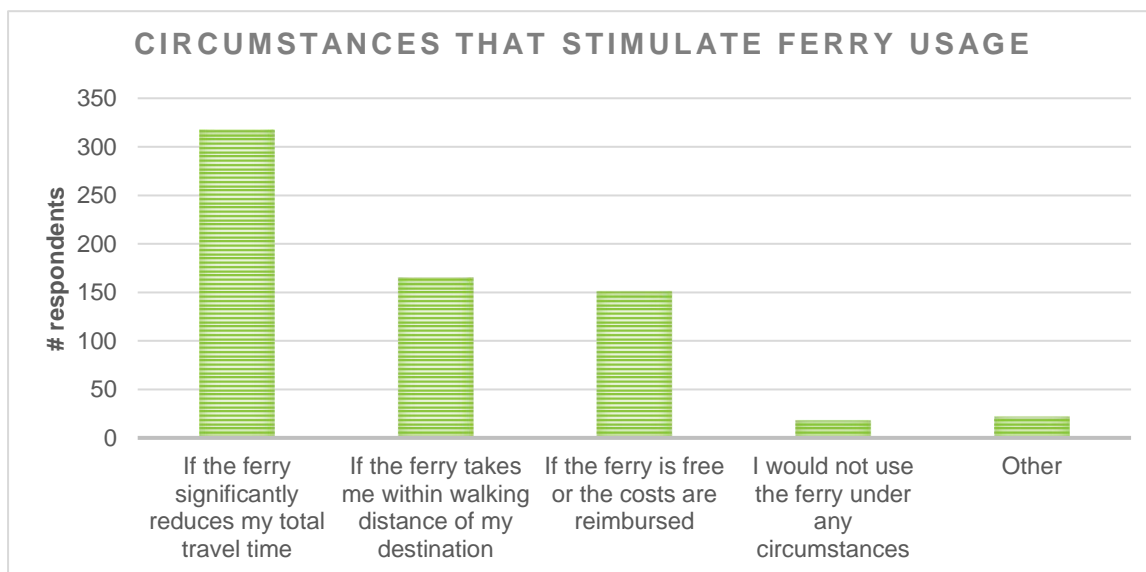


Figure 28 Circumstances that stimulate ferry usage (n=369)

When asked for motives to use the ferry as an alternative, 317 respondents mentioned the reduction of travel time as important motive. The directness and costs of the ferry were significantly less important. Other factors mentioned by respondents were reliability of the ferry (waiting times and delays), timetable (frequency and hours of service) and weather (not during rainy weather). These views on the use of a ferry as temporary alternative might also differ between different target groups. In chapter 5 the analysis of the data will be made further in-depth segregating different target groups and determining whether these target groups should be approached during projects such as the project around the Merweddebrug.

5. Target Group Analysis

5.1 SURVEY ANALYSIS

The segregation of target groups is based on the survey results and analysed on statistical significance to determine if the results differ from the expected results. Depending on the statistical segregation of the target groups which is performed, the most interesting target groups based on demographic and socioeconomic factors are further examined using more in-depth analysis of remaining questions.

5.1.1 Segregating target groups on attitude and significance

Based on demographic and socioeconomic values determined in the survey, the general attitude of different target groups can be determined and tested if statistical significance is reached in differences within any of these groups. These tests are performed with a set confidence interval. The first test to be performed concerns gender. Both male and female respondents were asked about general attitudes on using a ferry. This resulted in a mean value for the attitude, with male respondents averaging a value of 5,83 and female respondents averaging 6,60. Three respondents were listed as 'other'. This answer possibility was added to increase inclusivity of the question. However, only three respondents have used this answer which means individual responses influence the answer in this category massively. Due to the lack of respondents in this category this will not be taken into consideration when determining statistical significance. This means two answer categories remain for this question which are male and female. In academic literature, no sources were found to support the idea that male and female attitude on using a ferry differs, which means no difference between the different groups is expected for the t-test equality of means for both gender when compared to attitude towards travelling with a ferry.

	Levene's Test for Equality of Variances		t-test for Equality of Means						95% Confidence Interval of the Difference	
	F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	Lower	Upper
					One-Sided p	Two-Sided p				
Equal variances assumed	8,043	,005	-3,553	397	<,001	<,001	-,744	,209	-1,155	-,332
Equal variances not assumed			-3,543	381,699	<,001	<,001	-,744	,210	-1,157	-,331

Table 1 Independent sample test for means of gender on general attitude (n=399)

The results can be tested using a t-test for equality of means with the null hypothesis: There is no relation between gender and attitude to using a ferry in general. Using a two-tailed t-test for the equality of means, the results can be found in table 1. For a two-tailed test, the significance (p-value) is .005, which is lower than the value for α of .05. This means that there is a significant difference between the values and the null hypothesis can be rejected. There is a statistical significant connection between gender and ferry usage, indicating differences between the attitudes of male and female respondents on using a ferry. This is surprising, as no difference was expected between the different genders as there was no relation between gender and attitude found in literature or any other sources. This is taken into consideration in subgroups.

A similar test has been performed for different age groups and their attitude on ferry usage. In literature, no connection has been found to support the idea that particular age groups look more favourable upon ferry usage than other groups. Therefore, the null hypothesis states that there is no connection between age and ferry usage. This also means the same conclusion can be drawn when the null hypothesis is rejected, which means that there would be a connection between age and attitude on ferry usage. In this particular case, the question is whether both categorical variables are independent or related. By using a chi-square test of independence, this is tested because a chi-square test can be used to determine whether two variables are related. However, because there are a lot of cells in the chi-square test with an expected count less than 5, the Fisher's exact is not computable with available equipment because the amount of memory necessary to compute the Fisher's exact tests sample size is unrealistically high to be computable. A Monte Carlo simulation has been chosen as the alternative for this test (Mehta & Patel, 2010). The original results for the chi-square tests of independence for both variables can be found in table 2, with the confidence interval set to 95%. The Pearson Chi-Square significance found in the test is .105. However, with 59,1% of cells having an expected count less than 5 and the standard maximum for this number of cells being 20%, the Monte Carlo simulation was performed with standard values 99% confidence interval and 10000 sampled tables. The significance was then calculated to be .112. This again is well above .05 and this means the null hypothesis cannot be rejected. This means age group and attitude on ferry usage are not statistically significantly related.

	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)		
				Significance	99% Confidence Interval Lower Bound	Upper Bound
Pearson Chi-Square	40,001 ^a	30	,105	,112 ^b	,104	,120
Likelihood Ratio	45,712	30	,033	,029 ^b	,025	,033
Fisher-Freeman-Halton Exact Test	37,151			,066 ^b	,060	,072
N of Valid Cases	402					

a. 26 cells (59,1%) have expected count less than 5. The minimum expected count is ,09.

b. Based on 10000 sampled tables with starting seed 2000000.

Table 2 Chi-Square Tests of variables Age and Attitude (n=402)

Although gender and age were not particular target groups which could be found in literature, these demographic features have been tested on significant differences on ferry usage attitudes to test if target groups could be determined as these were two demographic features found to be used in the ODiN reports by CBS. Whereas gender did reveal to have a statistically significant relation with attitude, age group did not. A third possibility to distinguish target groups similar to those in ODiN reports is based on the occupation of the target groups. The means for the different occupations and attitude have been analysed. The null hypothesis for this test is: There is no relation between the occupation of the respondents and their attitude to using a ferry. Using a Chi-Square test, the statistical significance was calculated. Once again, as the number of cells with expected count less than 5 exceeded the standard maximum of 20%, a Monte Carlo Significance test was used to perform the calculation of significance. The result can be seen in table 3. With a statistical significance of .024 the null hypothesis can be rejected as this is lower than .05 and thus the alternative hypothesis can be confirmed. This means that there is a relation between occupations of the target groups and the attitude on ferry usage.

Similar tests have been performed to test whether car usage, public transport usage or bicycle usage variables have a relation with respondent attitude towards using a ferry. The Monte Carlo Sig. for car usage was .054 and this means there is no relation between car usage and attitude towards ferry usage. However, the means found for attitude in groups with different car usage was examined further. The mean attitude for people not using the car (6,14), using the car 1 or 2 days (6,55), or using the car between 3 and 6 days (6,29) are relatively similar and there seems to be no pattern in this statistic. However, the attitude of the group which uses a car more than 6 days per week is almost a single point lower on the numeral scale used with a mean of 5,53. This indicates a strong negative connection between daily car usage and attitude on ferry usage. However, more factors have to be taken into consideration when looking at the relation between car usage and attitude on ferry usage. Of the respondents indicating they use a car more than 6 days per week, more than 81% is currently employed and more than 56% of these employees are tight to a car for their trip to their work. Their dependence on a car should explain why the mean score for ferry attitude is lower, as 63% of the employees that use a company car would definitely not or probably not use the ferry as an alternative mode of transportation. Further elaboration on the attitude of respondents on different trip purposes and travel probabilities to use the ferry as an alternative will be made later in this paragraph.

	Value	df	Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)		
				Significance	99% Confidence Interval Lower Bound	Upper Bound
Pearson Chi-Square	49,028 ^a	30	,016	,024 ^b	,020	,028
Likelihood Ratio	52,872	30	,006	,008 ^b	,006	,010
Fisher-Freeman-Halton Exact Test	41,073			,026 ^b	,022	,030
N of Valid Cases	400					

a. 27 cells (61,4%) have expected count less than 5. The minimum expected count is ,19.

b. Based on 10000 sampled tables with starting seed 1314643744.

Table 3 Chi-Square Tests of variables Occupation and Attitude (n=400)

Looking at the other frequencies of modes of transportation and attitude on ferry usage, significance was also tested. For public transport usage, no relation between the amount of usage and the attitude to ferry services has been found as the significance is .098 with the Monte Carlo Sig. and 99% Confidence Interval with 10.000 sampled tables. This is also true for the relation between bicycle usage and attitude (.684). Both of these were not significant and thus a relation between usage of public transport or bicycle and attitude on ferry usage could not be proven. Therefore, no relation between current usage of a mode of transportation and attitude on ferry usage was found.

With significant relation between attitude with gender and attitude with occupations, some different target groups could be created based on these relations and the accompanying characteristics. The general attitude was tested on significance to anticipate what groups could be defined and to test relations between data. Now that significance has been tested, trip purpose attitude and probabilities of choosing the ferry as a temporary alternative are the most important questions which have been asked to respondents to indicate whether a ferry is indeed useful as mode of transportation for different trip purposes or circumstances. In the next paragraph, these questions are further examined, as well as other possible characteristics which can be derived from the questions asked in the survey.

5.1.2 Trip purpose attitude and travel probabilities

In academic literature, the only differences in target groups for ferry passengers were based on trip purposes. Purposes found in academic literature included trips to work or school, trips to shops, trips to family and friends or recreational trips. Because of the relation between gender and attitude as well as occupation and attitude, these different characteristics can be cross-examined to further study the links between trip purposes and gender or occupations.

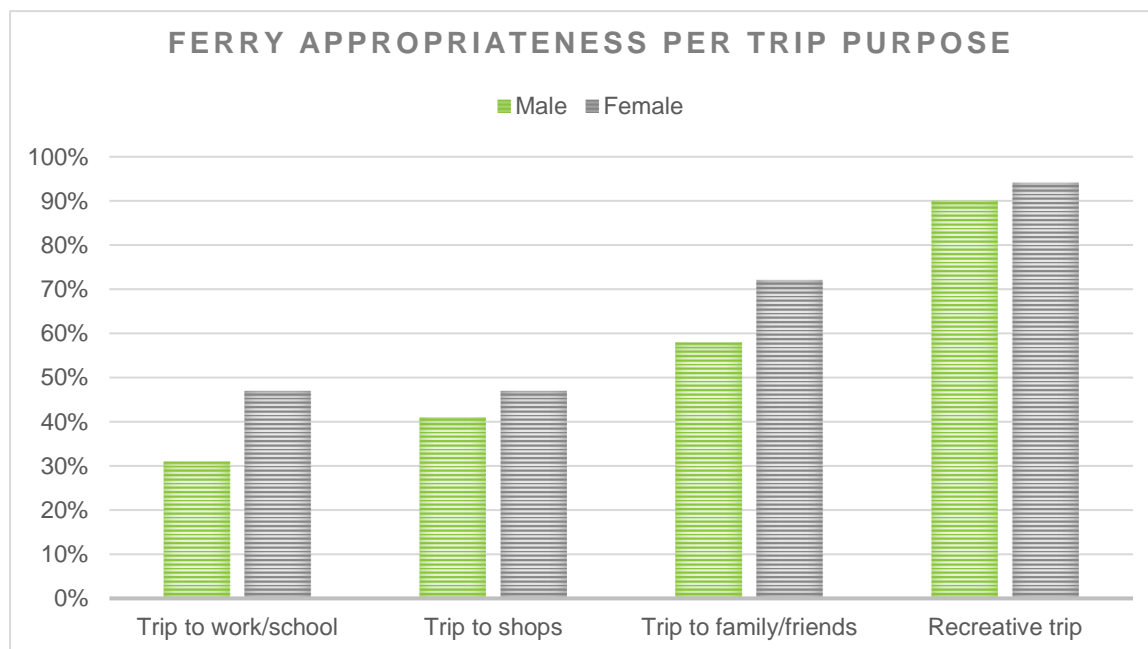


Figure 29 Ferry appropriateness of gender per trip purpose (n=399)

When it comes to the indication of appropriateness of ferries for a particular purpose, respondents were distinctly asked whether the ferry was an appropriate mode of transportation for a particular purpose before any indication about the temporary purpose which was specifically asked later was given. Because of the relation between gender and attitude, an analysis was made for the appropriateness of the ferry according to gender for different trip purposes. The result of this analysis can be found in Figure 29.

The percentage of respondents answering the question whether a ferry is an appropriate mode of transportation with either sometimes, often or always has been given. Most notably are the differences for different trip purposes. A ferry is most appropriate for recreational trip and trips to family and friends. Recreational trips reach a score of more than 90%, whereas trips to family and friends are well over 50%. For the purposes of going to shops, this number declined towards somewhat over 40%. These numbers are fairly equal for both genders. The biggest difference can be found for trips to work or school. In total female respondents were generally more positive on the appropriateness of a ferry, certainly for trips to work and school as well as for trips to family and friends. This can explain the relation between general attitude and gender which was found in the previous paragraph.

A similar analysis has been made for the different occupations and the appropriateness of the ferry as mode of transportation. Figure 31 showcases this analysis, in which percentages have been given for the number of respondents saying the ferry is appropriate sometimes, often or always again. The most notable effect in this figure is once again the superiority of recreational trips and trips to family and friends over trips to shops and trips to work or school. In general, students and employees think least favourable about using a ferry for trips to work and school with around 35% of respondents as well as to shops with around 40% of respondents.

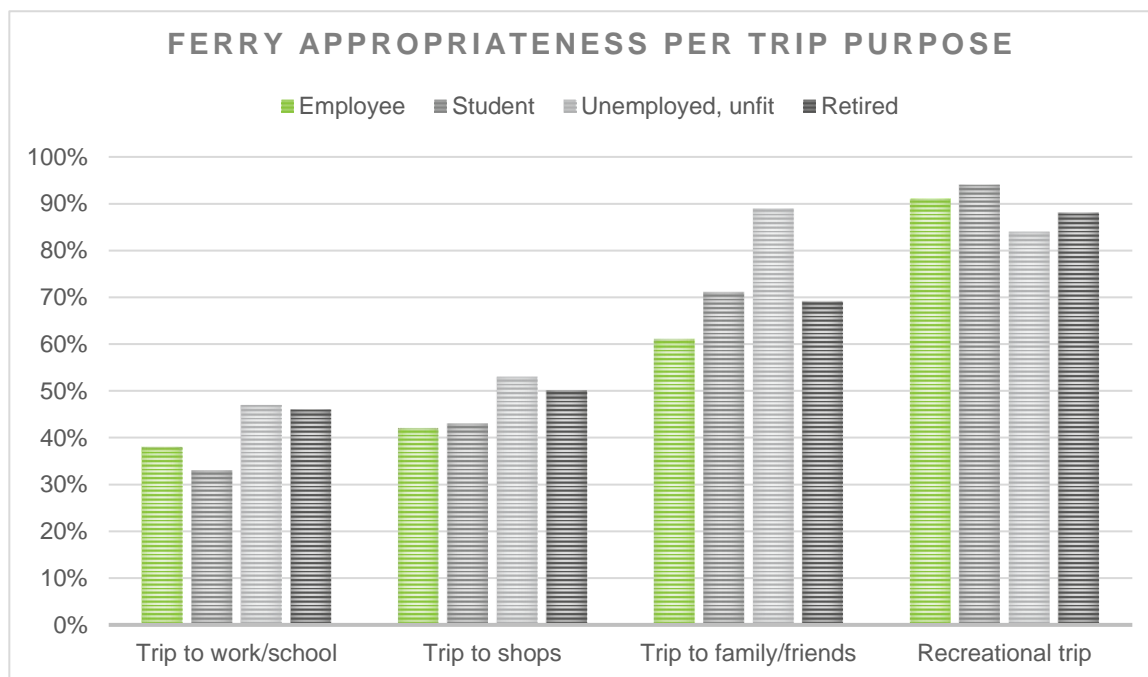


Figure 30 Ferry appropriateness of occupations per trip purpose (n=392)

For both employees and students, the number of respondents thinking positive about using a ferry for a trip purpose grows from less than 40% for work/school trips towards over 90% for recreational trips. Both occupations have quite a similar trend over the different trip purposes. This is different for unemployed and unfit respondents, which are generally more into using a ferry for trips, except for recreational trips in which they score lowest with just over 80%. Retired respondents had no exceptions, with the appropriateness of a ferry for trips to work or school lowest and recreational trips highest, although they will have hardly any trips for to work or school as they are retired.

Generally speaking, the relation between occupation and attitude in general can hardly be split over the different trip purposes. Besides some exceptions, employees and students think least favourable about using a ferry for different trip purposes. For all different occupations, the percentages are below 50% for trips to work/school as well as to shops. For all different occupations, the percentages are above 60% for trips to family/friends and recreational trips. Importantly, these results are not influenced by the idea of using a ferry as temporary alternative. This means that, without further notice, these percentages show the actual amount of people that think a ferry would be appropriate in any circumstances as part of their journey. This has to be taken into account for the approach of the target groups as their willingness to take the ferry into consideration as mode of transport in the first place will be influenced by this statistic.

Besides asking respondents about the appropriateness of the ferry as a mode of transportation for different trip purposes, respondents were also asked whether they would use a ferry as an alternative in a temporary situation. As mentioned earlier, based on academic literature the respondents were asked to take a ferry into consideration for the last part of their journey if they travelled by car or as an integral part of their journey if they travelled by bike or on foot. Once again, the two factors which have a significant relation (gender and occupation) were used to determine usage probabilities per trip purpose. In this case, the amount of respondents that have chosen for either positives 'probably' or 'definitely' can be seen as percentage of the total number of respondents for their respondent group.

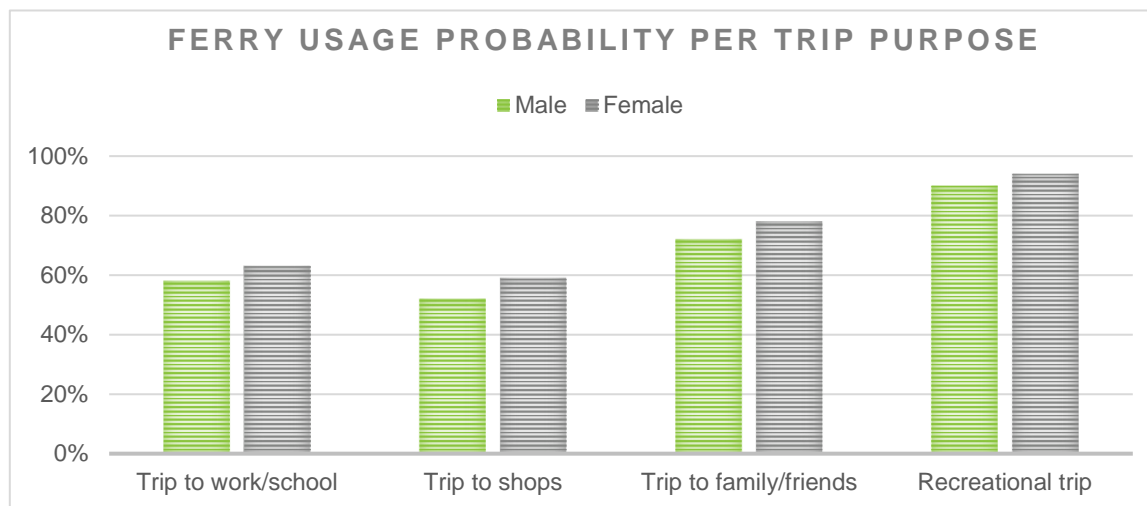


Figure 31 Ferry usage probability of gender per trip purpose (n=399)

Figure 30 takes gender and trip purpose into consideration. This figure shows an important shift in probabilities when compared to the appropriateness from Figure 28. When asked about the appropriateness of a ferry for different trip purposes, a distinctive difference could be seen between male and female respondents on trip purposes work/school and family/friends. When asked about using a ferry in a temporary situation, male and female respondent answers are more equal in their probabilities of ferry usage. This illustrates how male respondents are generally less willing to travel by ferry, yet will still use the alternative if it is the best option for their journey. When the trip purposes are compared, recreational trips and trips to family/friends remain the trips for which ferry usage is most probable. 90% of respondents would use the ferry as alternative for recreational trips, whereas more than 70% would use the ferry for trips to family and friends. This is more or less equal for both male and female respondents. These trip purposes thus also seem the most logical characteristics on which target groups can be differentiated. At the same time, the probability of ferry usage for trips to work and school has increased to around 60% when compared to the first indications of appropriateness which were around 30% (male) and 45% (female).

With this data, it seems the target group for the ferry would most likely include those with recreational trip purposes or those visiting family and friends, closely followed by those with a trip purpose to work/school and lastly trips to shops. Taking travel motives in the Netherlands (Figure 9) into consideration however, this can be doubted. Shopping and healthcare trips take up 27% of the total number of trips. Trip to work and school take up 23%, with family and friends only on 15% and recreational trips on 11%. It therefore seems the trip purposes for which travel over water are the most probable, are also the trips least common in the Netherlands.

However, this might be different when the probability of ferry usage per trip purpose are differentiated for occupations. The results can be seen in Figure 32, which again shows a similar pattern for recreational trips and trips to family and friends for which probabilities are highest. The only striking exception is the percentage of unemployed and unfit respondents and their probability to use a ferry to reach work/school.

The explanation for this statistic is probably related to the fact that these respondents do not travel to school/work and would therefore answer this question with either of both negative responses. Besides this, roughly the same patterns for occupations are shown as were shown for gender: Trips to shops are generally least probable to use a ferry in a temporary situation and recreational trips are most probable. And once again, the number of people that would actually choose for the ferry is higher than the number of people who think the ferry is appropriate. This is true for all different travel purposes.

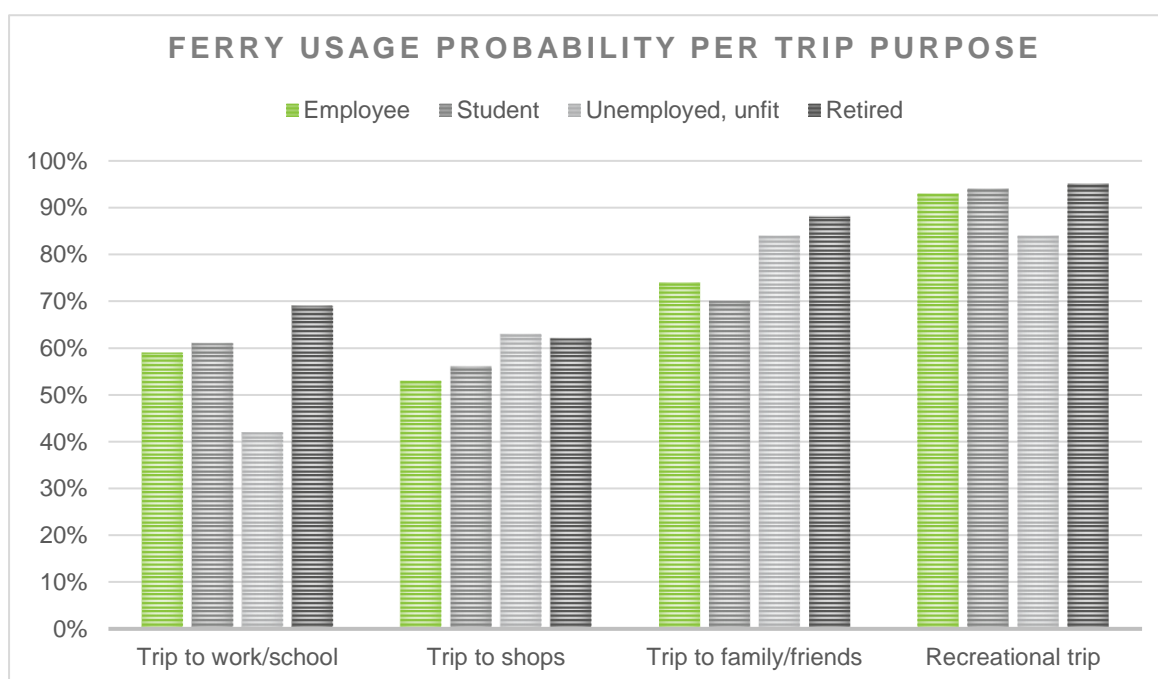


Figure 32 Ferry usage probability of occupations per trip purpose (n=392)

Some of the questions in the survey were related to company cars, travel frequency and travel distance. These questions were added to the survey based on input from the observations, in which concerns were raised about employees that depend on a company cars, have to travel to work daily or have to travel longer distances and their reduced opportunities to use a ferry. This genuine concern was put to the test in the survey as respondents that indicated they were either employees or students were given some follow-up questions.

Employees were asked about using a company car, going to work more often or travelling a further distance to work, whereas students were only asked about number of trips to school and travel distance to school. To test if these had any influence on these statistics, some comparisons have been drawn between the data in figure 32 and the data for particular subgroups based on answers of these questions:

- **Company car:** Of the 56 respondents who travel by company car, 55% would use the ferry in an alternative situation to go to work is. In general (Figure 32) this is 59%. However, employers were concerned about employees using a company car still using their car and refraining from using a ferry or any alternative, but this seems not to be the case.
- **Employee trips to work:** Of the 30 respondents who travel to work 1 or 2 times a week, 60% would use a ferry in a temporary situation. Of the 138 respondents who travel to work 3 or 4 times per week, this is 62% and of the 98 respondents who travel to work more than 4 times per week, this is 54%. In general (Figure 32) this is 59%. There seems to be no patterns of increasing or decreasing ferry usage for the number of times employees go to work per week.
- **Student trips to school:** Of the 9 respondents who travel to school 1 or 2 times a week, 67% would use a ferry in a temporary situation. Of the 35 respondents who travel to school 3 or 4 times per week, this is 69%. Of the 35 respondents who travel to school more than 4 times per week, this is 54%. In general (Figure 32) this is 61%. Once again, there seems to be no patterns in this statistic, although the group who travels to school more than 4 times per week is less likely to use the ferry than the other groups.

For both of these questions, there seems to be no logical pattern which can indicate further subgroups. The statistics show no logical patterns of increasing or decreasing possibilities and therefore these results do not provide a good enough basis to divide the respondents into subgroups. For the last question, this is different:

- **Employee distance to work:** Of the 72 respondents who travel less than 7,5 kilometres to work, 68% would use a ferry in a temporary situation. Of the 47 respondents who travel between 7,5 and 15 kilometres to work, this is 70%. Of the 64 respondents who travel between 15 and 30 kilometres to work this is 52% and of the 90 respondents who travel to work over 30 kilometres this is 51%. In general (Figure 32) this is 59%.
- **Student distance to school:** Of the 18 respondents who travel less than 7,5 kilometres to school, 72% would use a ferry in a temporary situation. Of the 15 respondents who travel between 7,5 and 15 kilometres to school, this is 80%. Of the 15 respondents who travel between 15 and 30 kilometres to school this is 53% and of the 32 respondents who travel to school over 30 kilometres this is 53%. In general (Figure 32) this is 61%.

These numbers clearly show increasing differences between subgroups. For employees, a ferry seems to be a probable alternative on a trip with a maximum of 15 kilometres. Around 70% of surveyed employees that travel a maximum of 15 kilometres to work think the ferry is a probable alternative, compared to only around 50% for employees travelling further than 15 kilometres. This indicates a ferry is most likely to be used predominantly by local traffic. For students this is also true for a travel distance less than 7,5 and between 7,5 and 15 kilometres for which around 70% to 80% answered 'probably' or 'definitely'. Above 15 kilometres, the numbers drop quickly towards 50% and 51%. For actual use of the ferry as an alternative in a temporary situation, trip purposes and travel distances are the two factors on which potential passengers can be targeted best. This means the approach of target groups for the ferry has to be aimed at the best possible targeting of these groups within the system.

5.2 TARGET GROUP APPROACH

Based on the findings from paragraph 5.1 several target groups can be created based on the travel probabilities for the ferry as an alternative during temporary situations. These target groups are based on different trip purposes and travel distances. Particular target groups are:

- Passengers with a recreational trip purpose
- Passengers who are travelling to family or friends
- Passengers who are travelling to work/school with maximum travel distance 15 kilometres

These three target groups are generally more open for a journey in which the ferry can play a role than others, specifically for temporary situations. Based on these three target groups communication towards potential passengers can be specified. Although these three groups have been determined as promising groups, other target groups should not be excluded completely from the approach. In the next paragraph, more about the approach in general and specifically for the situation around the Merwedeburg will be explained.

5.2.1 Target groups and target area

The three target groups should be targeted using simple yet effective communication by RWS and BMN. A very important characteristic of potential passengers is the fact that the majority of potential passengers will be located within a 15 kilometre radius from the ferry network by Riveer, with an even higher share of potential passengers within a walking radius from the ferry network. In ODin, the average walking distance for a trip is 2 kilometres (CBS, 2022), which will be taken into consideration for the target area as well. When given these distances, target areas can be defined for case studies as can be seen in figure 33 in which the situation around the Merwedeburg has been further worked out. The wide target area is the 15 kilometre radius, whereas the smaller circles within that area have the 2 kilometre radius from the ferry network.

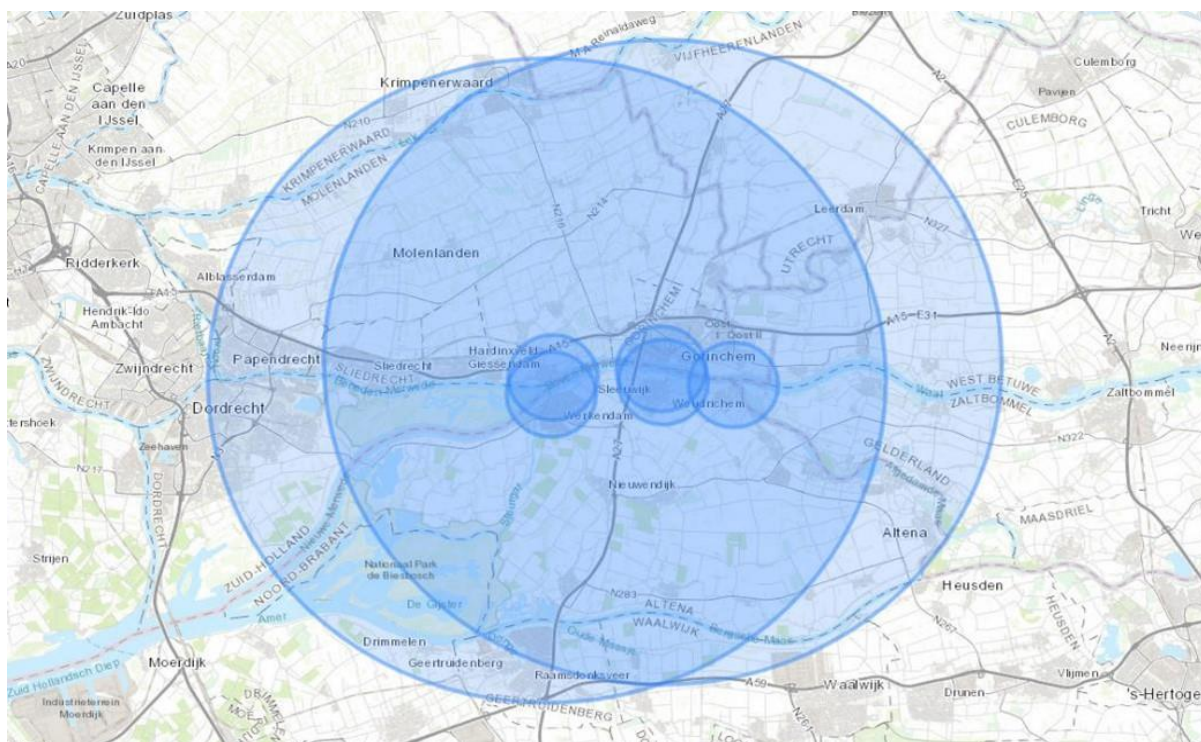


Figure 33 Target areas for passengers communication (OpenStreetMap, 2023; adjusted)

The circles in Figure 33 can only be used as an indication, as these circles are 15 straight kilometres on a map, which is different from actual travel distances. Not everyone within these circles will be able to use the ferry, but those with a destination within the smaller 2 kilometre radius circles on the other side of the river will have the most potential and can be targeted by BMN and geotargeting. This also includes looking at location specific origins and destinations for different trip purposes using geotargeting:

- Passengers with a recreational trip purpose can be approached using geotargeting. Based on their travel patterns in the region, search results for touristic destinations and other characteristics, they can be distinguished from travellers with other trip purposes. These recreational travellers should be informed about the possibilities to travel with a ferry before their journey has even started.

It is important for RWS to approach destinations in the area and offer appropriate solution for decreased accessibility. For example, RWS should seek contact with the municipality of Gorinchem in order to make it possible to influence travellers that visit the fortified inner-city of Gorinchem. This approach should also include travellers to important tourism destinations in the region, such as Slot Loevestein and Fort Vuren as well as recreational visitors for other villages directly within walking/cycling range of the ferry network. Cooperation between RWS and local organisations such as municipalities is vital to reach these travellers, as local authorities will also know which institutions, hotels and other companies should be involved to create a successful approach for recreational travellers. RWS should use an overarching geotargeting approach to reach out to these travellers.

- Passengers who are travelling to family or friends can be approached using geotargeting which should be aimed at reaching all inhabitants in the radius of the ferry network. However, it is very important to target those that will receive guests, instead of solely targeting those that will actually travel. This is mostly true for all inhabitants of villages directly located at the river Merwede within walking or cycling distance from the jetties from Riveer.
- Passengers who are travelling to work/school with a maximum travel distance of 15 kilometres should be approached using the employers' approach by BMN. This group has a large potential as there are an estimated 40.000 jobs within a 10 kilometre radius of Gorinchem and over 110.000 within 20 kilometres (CBS Statline, 2023). Anyone living within a 15 kilometre radius from their employer should be considered as potential passengers for the ferry. Using the ferry as an alternative and thus as a mobility management measure for the project on the A27 is important and thus the ferry as an alternative should be added to the list used by BMN as possible measures. Outside the 15 kilometre radius, employers can be informed about the possibility to use a ferry as well. This is certainly true for employers within walking distance from ferry locations.

The fourth target group is a remaining group of potential passengers who do not belong to the three groups specified above. These include travellers that with a trip purpose of going shopping or travellers with any other motives not specified in the approach mentioned above. Although their potential is lower than those mentioned above, these passengers should not be forgotten.

5.2.2 Target group communication approach

There are some important differences between the different target groups and the way these groups should be approached by RWS and BMN to optimize the effectiveness of their communication. In the first place, a division should be made between different target groups for both RWS and BMN. BMN is responsible for the approach of all employees and students in the region, both those with a trip of less than 15 kilometres as well as employees and students who have a longer trip. Within the employers' approach BMN can roll out a communication campaign for the employees and students in the region aimed at stimulating ferry usage. This approach of BMN should be similar to their approach on cycling stimulation. The emphasis should be on employees with a maximum trip length of 15 kilometres. Important in the communication strategy of BMN is also the motive used during communication to attract passengers. Besides the fact that reconstruction will result in hindrance in the region, the emphasis in communication should be on travel time saved by employees when a ferry is used for their trip as this is their main motivation to use the ferry. On top of that, the length of the hindrance can be used to further stimulate ferry usage and create awareness for the duration and impact the reconstruction of the A27 will have on the region. Using these factors in the communication strategy for employees and students will maximize effectiveness of the approach by BMN.

On the other hand, RWS will be responsible for other target groups, the approach of potential passengers with a shopping or recreational motive, as well as the approach of potential passengers with (un)identified trip purposes that are different from the three main target groups. These potential passengers should be approached using the geotargeting areas mentioned in 5.2.1 and the communication should be aimed at creating awareness of the problem and hindrance, but should also transfer a positive message about the ferry as a mode of transportation in general. This last factor is certainly true for passengers with a recreational trip purpose. Ferry usage appropriateness for this trip purposes is generally very high and therefore putting the ferry in a good light might be enough to persuade potential passengers, which is different to the approach of employees and students. At the same time, communication strategy by RWS should include cooperation with local tourism destinations and institutions to maximize the reach of the communication campaign.

An important addition to both the strategies of BMN and RWS is the fact that the attitude of respondents on ferry appropriateness is lower than the actual probability respondents would use the ferry when confronted with the hindrance. Therefore, both BMN and RWS should communicate elaborately and in detail about the cause of hindrance, then using the opportunity to suppose a ferry as solution to the problem. On top of that, because of the statistical significant difference between male and female respondents on the usage of a ferry, there is another important addition to the communication strategy: The focus of the communication campaign should take into consideration how potential male passengers are less likely to think of the ferry as an appropriate alternative in general. A strategic way to convince potential passengers based on the results of the survey might be using peer examples which have used the ferry before. The attitude on using a ferry amongst those who do so regularly is way better than the attitude of those who rarely or never use the ferry. This can indicate a lack of knowledge about the benefits of the ferry as a mode of transportation, as well as a possible barrier to start using the ferry for the first time. Indicating a ferry is present at a certain location is therefore a good start, but using regular ferry users as key ambassadors in communication towards possible new users can be of strategical advantage. Using male ambassadors to specifically also target potential male passengers can be important to maximize the effect of the communication strategy.

5.2.3 Merwedebrug target group impact

When this approach is used on the case study at the Merwedebrug, the number of trips made between villages in the vicinity of the ferry network by Riveer can be used to estimate passenger potentials. On an average weekday, almost 6.500 people travel between the villages on either sides of the river Merwede around the Merwedebrug. This number declines to almost 4.000 on an average Saturday (Mobycon, 2017). The number of people using the ferry is currently low, as the share of passengers using the ferry is normally between 4% and 17%. Based on the data gathered by Mobycon (2017) in their report about the services of Riveer, an estimation can be made about the number of cross-river local trips per trip motive. These numbers are based on the total number of trips made, the data gathered for employees and students as well as general data on the number of trips made per travel motive in the Netherlands by CBS. The estimations in Tables 4 and 5 are therefore no more than indications of the number of potential passengers and should not be seen as factual.

Weekday	Local trips	Probability	Potential Passengers
Work	2.000	60%	1.200
School	600	60%	360
Shopping	1.000	55%	550
Family/friends	500	75%	375
Recreational	200	85%	170
	Total		2.655

Table 4 Estimation of weekday ferry potential

The ferry will be important to improve accessibility during periods in which this accessibility is under pressure. On an average weekday, the total number of potential passengers is just over 2.500. The majority of these are employees that travel between the villages in the region, belonging to the target group of employees that travel less than 15 kilometres to work. Shopping is the second biggest trip purpose that contributes to potential passengers, even despite the probability being the lowest of all trip purposes.

Weekend	Local trips	Probability	Potential Passengers
Work	0	60%	0
School	0	60%	0
Shopping	1.700	55%	935
Family/friends	700	75%	525
Recreational	1.200	85%	1.020
	Total		2.480

Table 5 Estimation of weekend ferry potential

For a day in the weekend, the number of trips to work and school has been set to zero. Of course, this will not be entirely true as there are still people working, certainly on Saturdays. However, Mobycon calculated the number of trips in the region and did not take any weekend trips with a trip purpose of going to work into consideration. This means the ferry will mostly be used by recreational passengers during the weekend, as well as people who will go shopping. Of course, the company of Riveer is not unfamiliar with recreational passengers as its network also extends to Slot Loevestein and Fort Vuren which are two touristic landmarks in the region. The potential passengers who currently only use the ferry to get to these landmarks, might also use the ferry to reach either side of the river during temporary closures.

5.2.4 Ferry conditions

The number of potential passengers is relatively high, certainly when compared to the number of passengers Riveer currently services. However, there are some important conditions which have to be fulfilled by Riveer to convince the potential passengers to actually use the services.

The most important factor for potential passengers is travel time. Using an alternative for their trip which would normally be taken by car is not a problem when the travel time saved is large enough. In the scenario used in the survey, respondents were asked if they would use the ferry if it would save them 20 minutes of travel time for a single trip. More than 75% of respondents would only use the ferry if it would really make a difference in their total travel time. This means that the ferry should be frequent enough to save travel time at all times, or punctual enough for passengers to determine at what time they should be at the jetty. This condition should be fulfilled by Riveer using either their app as to give passengers specific indications about departure times as well as further increasing the number of services provided to compete with other modes of transportation. This should be tested manually during the different stages of the project by comparing travel times for different modes of transportation between the villages in the region and testing whether the ferry will actually save travel times. The determination of potential passengers in the previous paragraph was performed with travel time saved at 20 minutes. Any more time saved might provide extra passengers, whereas any less time saved might decrease the number of potential passengers.

Travel costs was one of the predominant conditions found in academic literature. However, based on the survey it can be concluded that the reduction of travel time is the most important factor for the respondents. Travel costs and a possible reduction of travel costs are certainly also a factor which can contribute to the success of the ferry. However, because of the impact of reconstruction and the threat of extra travel time, it seems travel costs is only of limited influence. In general, BMN should take travel costs into consideration in their meetings with employers as some sort of

One of the other conditions which has to be fulfilled by Riveer is a possible extension of the service hours. At the moment, the ferry services start around 6:30 and the last ferries leave around 18:00. However, respondents of the survey expressed their concerns about the hours during which the ferry is active, as for example any delay on their work or any activity which lasts past 18:00 would oblige them to use the car as the ferry would not be an alternative. These problematic scenarios should be avoided and the ferries should remain active past 18:00 to support potential passengers going home. Of course, depending on the situation, Riveer might choose to downgrade the frequencies later in the evening. Their service later on the day could be made comparable to their Saturday timetable, in which the frequency is lower than normally. This condition is most certainly important for employees, students and people who go shopping, as they will most likely return home at the end of the day by using the ferry. Without certainty that they can return home after they have spent their day, these potential passengers are very unlikely to use the ferry for their journey.

6. Conclusion and Discussion

6.1 FERRY SERVICE OPPURTUNITIES

This research was performed to answer the research question: How and by whom can travel over water be used to mitigate hindrance during periods of (partial) road closures, in particular for the case study at the bridge over the river Merwede?

6.1.1 Travel over water as an alternative

When it comes to travel over water, a ferry for pedestrians and cyclists can play an important role in mitigating hindrance in the Netherlands. With their unique role in the transportation network, ferries provide accessibility, mostly in urban regions, and act as an alternative for (often congested) other transportation networks. However, as the opportunities to use a ferry are limited, there are only few ferry networks around the world and academic literature on ferry services is scarce. This is partially caused by the fact that there is no one-size-fits-all solution for ferry networks, as the networks are completely dependent on the availability of water and jetties. Most research into ferry services has been conducted on long-haul ferry services, but these services rely heavily on freight operators instead of passengers. Therefore, only limited information is available about the characteristics of the passengers on these ships. Research into characteristics of passengers on local urban ferries is also scarce. However, as these ferries often connect parts of a city with each other, ferry services take local demand into consideration and therefore some information is available on the target groups that are serviced by these ferries. In all cases studied, recreational passengers are frequent on ferries and are (among) the most dominant target group. Some ferries also service large amounts of commuters and these are mostly located within large urban areas.

In the past, a ferry has been used as part of mobility management in the Netherlands. However, there was no academic literature to support the deployment of this ferry as an alternative for traffic unable to use the highway which was reconstructed. One international academic source could be found which described a ferry network as potential alternative mode of transportation for congested road networks. However, travel over water is a niche and is only available in very limited places. Understanding attitudes and determining target groups was therefore vital to understand the possibilities to actually use travel over water as an alternative.

Considering the attitude of Dutch inhabitants on using a ferry as an alternative during a temporary situations, the most important subdivision of the population was made based on statistically significant differences for different occupations (.026 with 95% confidence interval and 5% margin of error) and their attitude on using a ferry for different trip purposes. For a trip to work or school with a maximum length of 15 kilometres, more than 60% of surveyed commuters and students would use a ferry. Using travel over water as an alternative is even more likely for other trip purposes. Around 75% of surveyed respondents would use a ferry for a trip to family or friends, 85% would use a ferry as part of a recreational trip. RWS should focus their approach on these target groups and use BMN, geotargeting and cooperation with local institutions to target these groups. Because of a statistically significant negative attitude (.005 with 95% confidence interval and 5% margin of error) on ferry usage for male respondents in comparison to female respondents, communication should also be adapted to boost ferry usage among male respondents.

6.1.2 Conclusions for the Merwedeburg case study

Although it is known that ferries can be used as mobility management measure, the parties involved in the project around the Merwedeburg (which in this case are RWS and BMN) seem reluctant to do so on a large scale as they are currently unfamiliar with the possibilities a ferry network actually provides. RWS and BMN also know that the travel time for traffic over the Merwedeburg will increase significantly during the next years and seek solutions for these problems. The ferry services of Riveer which are currently already available provide them with this opportunity. Although the exact planning of the reconstruction of the A27 is currently still unknown, RWS and BMN do know that the travel time will be increased by at least 10 to 30 minutes during reconstruction and the Merwedeburg will be closed for all traffic from time to time. With different mobility measures, the total amount of vehicles over the bridge should be decreased by around 3.000 vehicles per day. The ferries by Riveer might therefore provide the ideal solution to keep the region accessible.

Earlier efforts by RWS to facilitate ferries during other projects were successful, but only limited information on these ferries is available. The situation around the Merwedeburg is generally different from those other situations as well, with a small ferry network already available around the Merwede. When the situation around the Merwedeburg is considered, the total number of potential passengers can be determined by taking ferry usage probabilities from the survey analysis into consideration and projecting these probabilities on the number of trips made in the villages around the Merwedeburg.

This eventually leads to a potential of slightly over 2.500 passengers on a weekday. Most of these passengers make a trip to work and use the ferry as the alternative for their journey. At the same time, the second biggest group of potential passengers in absolute number is the group which has a 'shopping' travel motive. The total number of potential passengers during the weekend is slightly less than 2.500. These consists mostly of passengers with a recreational trip purpose or with a shopping trip purpose. These different target groups should be taken into consideration both by RWS and BMN as the contribution of trip purposes on the total amount of passengers changes depending on the time of the week.

The number of passengers which will actually be reached depends on the different mobility management measures implemented, but also on the service provided by Riveer. Important conditions which can influence the success of the ferry are the frequency and reliability of the services provided, as well as the service hours of the ferries. Decreasing travel times is most important according to the survey responses and are heavily dependent on the factors mentioned. When these conditions are met, the ferry can fully function as part of mobility management in the region.

Ferries can indeed play an important role in mitigating hindrance during periods of road closures, especially for the different target groups which have been distinguished. Although a ferry is not a mode of transportation regularly used as mobility management measure, it provides RWS and BMN with the unique chance to include a completely new travel option to their existing mobility management measures and provide new opportunities to keep the region accessible. Based on the results of this research, it is highly recommended that RWS and BMN include the ferry service in their mobility management and communicate about this new travel option, especially towards the target groups which have been distinguished.

6.2 DISCUSSION

Determining what the potential of the ferry is and what target groups might be interested in travelling with the ferry is quite a broad research topic. As mentioned before, using this broad research topic was preferred because only limited research has been done on ferries in the first place and nation-specific research for the Netherlands does not exist yet. This means trying to establish a good picture of the target groups and number of potential passengers for the case study around the Merwedeburg is new, useful information for RWS and other institutions. However, it also means that there are some limitations to the research, as well as new insights worth diving deeper into in other studies.

6.2.1 Practical and theoretical assumptions

One of the limitations is a lack of previously performed target group research specifically for ferries, which means questions in the survey and testing stated preference could only be verified by looking at surveys for other modes of transportation. Of course, the demographic features on which the ferry target groups were tested were taken from general studies on travel patterns. Although these features can be used to conduct this research, any research previously performed in which relations between demographic or socioeconomic features and ferry usage had been tested would have been useful to further specify research questions for this study in the Netherlands. In this study, statistically significant conclusions could only be drawn over the entire sample and therefore could only be focused on the overarching questions for stated preference.

Furthermore, consumer preference studies (Corte, Cairns & Grieve, 2021; Quaife, Terris-Prestholt, Luca Di Tanna & Vickerman, 2018; Viney, Lancsar & Louviere, 2002) revealed there may be differences between stated and revealed preference when stated preference (SP) surveys are used. Therefore SP surveys may not predict actual behaviour, which results in hypothetical bias. Systemic bias in SP responses or difficulty in carrying out the SP task (which is using a ferry in this case) can be the cause of this difference. Because there are no known records of observed revealed preference studies when it comes to using a ferry as an alternative, it is not possible yet to compare stated preference with observed choices. Therefore, the results from the SP survey used in this study can diverge from actual behaviour which will occur in these situations.

On top of that, some of the conditions which have to be fulfilled by Riveer to successfully attract potential passengers have financial consequences. For example, upgrading or at least maintaining high frequencies of ferry departures can impact the finances of Riveer. This is most certainly true for the extension of the hours during which the ferry is active, which should be extended as the service has to start earlier in the morning and end later in the evening to attract many of the potential passengers in the target group of the employees. To give an indication of the costs, RWS (2017) can be quoted: 'In the case of structural deployment of a foot passenger-bicycle ferry, the average cost per passenger is €9.13. The bandwidth here ranges from €3.31 to €13.38. With a public transport fare, the cost recovery does not exceed forty to fifty per cent. The remaining part of the costs must be supplemented by a contribution from public funds. For the Waterbus in Rotterdam, for example, an hour's transport costs €250. The deployment of an extra ferry in the case of road works on the A10 costs €180 per hour.' This might be different for Riveer, but should be addressed within their financial capacities. Based on the expected amount of travellers as business case can be created to calculate whether adding a ferry or increasing frequencies on existing ferries can be used to increase service availability.

6.2.2 Practical recommendations and future research

The research that has been performed and the conclusions that have been drawn give primary insights on possibilities to use travel over water as an alternative, but can also be used to describe practical recommendations for society and the interests of stakeholders, as well as possibilities to conduct future research.

In terms of practical recommendations, the stakeholders (most notably RWS and BMN) can now focus on ferry usage target groups as they further specialize their mobility management measures. As this research was reasonably broad and distinguished particular target groups, these first conclusions in terms of potential target groups and statistically significant differences between these groups are helpful to further distinguish what services RWS and BMN will use to approach potential users. Practical recommendations include approaching employees and students within the target group by using the employers' approach of BMN, as well as approaching the other target groups using different communication methods and cooperating with other companies and institutions to maximize the effect of the efforts of RWS.

Of course, these efforts should be considered within the framework of multiple mobility management measures and travel over water should not be a sole effort to solve the accessibility problems in a region. Therefore, an indication of the success of travel over water in mobility management should be included in further research by RWS to evaluate how successful this particular measure is. A comparison between different mobility management measures might be performed, in which the ferry service and its potential, as well as revealed impact have to be considered in comparison to other measures. This should also include further in-depth identification of potential target groups as RWS and BMN deploy different mobility management measures and it would be interesting to test what measures fit best with the inhabitants and visitors in the region. For example, commuters can be asked whether they would use the ferry service, or rather work from home more often during periods of hindrance. Comparing these measures would also make it possible to further specify the number of potential passengers for the ferry services in relation to other mobility management measures.

When it comes to the impact of the ferry during other projects by RWS, it would be interesting to conduct follow-up research during and after the project into the revealed preference of the population and compare this with the stated preference which has been determined in this research. This would make it possible to reveal differences between stated and revealed preference as well as further identify what target groups will use travel over water as an alternative. On top of that, any particular target groups that have been distinguished can be studied more in-depth in follow-up research. An example is the target group of employees and students within 15 kilometres of the ferry service, which can be studied more in-depth to determine possible motives or barriers to use travel over water on a statistically significant scale.

Conducted follow-up research on the success of travel over water as a mobility management measure, as well as further determining what factors contribute to the success of travel over water for different target groups are vital to understand how this mode of transportation can help RWS in the future. These studies would also contribute to creating a more supported and integral view of the possibilities to use a ferry.

Bibliography

- Algerie Ferries (2022). *Horaires*. Algerie Ferries. <https://www.algerieferries.com/horaires>
- ANWB (2022, December 31). *Files in 2022 terug van weggeweest*. ANWB. <https://www.anwb.nl/verkeer/nieuws/nederland/2022/december/files-terug-van-wegge-weest>
- Baez, D., Brashaw, J., Intelandi, M. & McNamara, C. (2018, March 2). *Water Taxis in Hong Kong: Their Potential and Future*. https://web.wpi.edu/Pubs/E-project/Available/E-project-030118-223158/unrestricted/Water_Taxis_in_Hong_Kong.pdf
- Baird, A. J. (1997). *A Scottish east coast European ferry service: review of the issues*. Journal of Transport Geography. Volume 5, Issue 4, December 1997, pp. 291-302
- Baird, A. J. (1999). *A comparative study of the ferry industry in Japan and the UK*. Transport Reviews. Volume 19, Issue 1 (pp. 33-55). <http://dx.doi.org/10.1080/014416499295664>
- Baird, A. J. (2012). *Comparing the efficiency of public and private ferry services on the Pentland Firth between mainland Scotland and the Orkney Islands*. Transportation Business & Management. Volume 4 (pp. 79-89). <https://doi.org/10.1016/j.rtbm.2012.06.001> Cowie, 2012
- BC Ferries (2019). *Annual Report to the British Columbia Ferries Commissioner*. British Columbia Ferry Services Inc. https://www.bcferries.com/web_image/h70/h94/8798744772638.pdf
- Bishara, A.J. & Hittner J.B. (2016, January 28). *Confidence intervals for correlations when data are not normal*. Behaviour Research Methods. Volume 49 (pp. 294-309). <https://doi.org/10.3758/s13428-016-0702-8>
- Blue Star Ferries (2023). *Blue Star Naxos*. Blue Star Ferries. <https://www.bluestarferries.com/en-gb/our-fleet/blue-star-naxos>
- BMN (2023). *Samen voor een duurzaam bereikbaar Brabant*. BMN. <https://www.brabantmobiliteitsnetwerk.nl/over-bmn/werkgeversaanpak/>
- Boquet, Y. (2012). *Moving around the Philippines: Challenges and dynamics of inter-island transportation in a developing country*. Hong Kong Society for Transportation Studies.
- Bos, L., Kamphuis, A., Dreyer, M. & Voorn, M. (2020, December 3). *Minder Hinder; Onderzoek naar de beleving van hinder bij wegwerkzaamheden*. <https://zoek.officielebekendmakingen.nl/blg-1014034.pdf>
- Britannica (2023a). *Ferries*. Britannica Dictionary. <https://www.britannica.com/technology/ship/Ferries>
- Britannica (2023b). *The Atlantic Ferry*. Britannica Dictionary. <https://www.britannica.com/technology/ship/The-Atlantic-Ferry>
- Carnay, S., Zielinski, E. & Zaranko, A. (2012, January 1). *New York City's East River Ferry: Expanding Passenger Ferry Service and Stimulating Economic Development in the New York City Region*. Transportation Research Record: Journal of the Transportation Research Board. Volume 2274, Issue 1. <https://doi.org/10.3141/2274-21>
- CBS (2020, December 12). *Verkeersintensiteit; Rijkswegen*. CBS. <https://www.cbs.nl/nl-nl/cijfers/detail/82855NED#shortTableDescription>

- CBS (2022, February 10). *Onderweg in Nederland (ODiN) 2018-2020*. CBS. <https://www.cbs.nl/nl-nl/longread/rapportages/2022/onderweg-in-nederland--odin---2018-2020/3-reizigerskilometers>
- CBS (2023). *Bevolkingsteller*. CBS. <https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/bevolkingsteller>
- CBS Statline (2023). *Nabijheid voorzieningen; afstand locatie, regionale cijfers*. CBS. <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80305ned/table?fromstatweb>
- Cheemakurthy, H., Tanko, M. & Garne, K. (2017). *Urban Waterborne Public Transport Systems: An Overview of Existing Operations in World Cities, Technical report*. <https://www.diva-portal.org/smash/get/diva2:1168873/FULLTEXT01.pdf>
- Corte, K., Carins, J. & Grieve, R. (2021, March 9). *Stated versus revealed preferences: An approach to reduce bias*. Health Economics. Volume 30, Issue 5 (pp. 1095-1123). <https://doi.org/10.1002/hec.4246>
- DFDS (2023a). *Annual Report 2022*. DFDS. https://downloads.ctfasets.net/mivicpf5zews/30de54Ianj9yGhj-vOxz11/8699bff2907d57956e6538a342c06514/DFDS_NO_10_24_02_2023_ANNUAL_REPORT_2022.pdf
- DFDS (2023b). *European ferry routes*. DFDS. <https://www.dfds.com/en/passenger-ferries/ferry-crossings>
- Diaz, C.E.D. (2011). *Mode Choice of Inter-Island Travellers: Analyzing the Willingness of Ferry Passengers to Shift to Air Transportation*. Journal of the Eastern Asia Society for Transportation Studies. Volume 9.
- Ewing, K.D. (2022). *Business and Human Rights: A P&O Ferries Case-Study*. International Union Rights. International Centre for Trade Union Rights. Volume 29, Issue 1 (pp. 16-18). <https://muse.jhu.edu/article/854569>
- Groningen Bereikbaar (2020, April). *Resultatenfolder Groningen Bereikbaar 2020*. Groningen Bereikbaar. Resultaten (pp. 2-3). [https://www.groningenbereikbaar.nl/toolkit/\\$8012/\\$8011](https://www.groningenbereikbaar.nl/toolkit/$8012/$8011).
- GVB (2023a). *Routes and schedules*. GVB. <https://reisinfo.gvb.nl/en/lijnen/F2>
- GVB (2023b). *Onze veren*. GVB. <https://over.gvb.nl/ov-in-amsterdam/voer-en-vaartuigen/veren-in-cijfers/>
- Harbers, M. & Heijnen, V.L.W.A. (2022, November 30). *Rapportages Staat van de infrastructuur van Rijkswaterstaat en ProRail en Prognoserapport Vervanging en Renovatie Rijkswaterstaat*. Ministerie van Infrastructuur en Waterstaat. <https://www.tweedekamer.nl/downloads/document?id=2022D50716>
- Hebbar, A., Yildiz, S., Kahlouche, N. & Schröder-Hinrichs, J. (2023, January). *Safety of domestic ferries: A scoping study of seven high-risk Safety of domestic ferries: A scoping study of seven high-risk countries*. World Maritime University. https://commons.wmu.se/cgi/view-content.cgi?article=1086&context=lib_reports
- Jahn, O., Möhring, R.H., Schulz, A.S. & Stier-Moses, N. (2005, August 1). *System-Optimal Routing of Traffic Flows with User Constraints in Networks with Congestion*. Operations Research. February 2004. <https://doi.org/10.1287/opre.1040.0197>
- Jorgensen, F., Mathisen, T.A. & Larsen, B. (2011). *Evaluating transport user benefits and social surplus in a transport market—The case of the Norwegian ferries*. Transport Policy. Volume 18, Issue 1 (pp. 76-84). <https://doi.org/10.1016/j.tranpol.2010.06.002>

- KiM (2022, November). *Kerncijfers Mobiliteit 2022*. KiM. https://www.kimnet.nl/binaries/kimnet/documenten/publicaties/2022/11/15/kerncijfers-mobiliteit-2022/Kerncijfers+Mobiliteit+2022_A_def.pdf
- Kim, T.H., Ha, J.M., Lim, J.M. & Park, J.J. (2009, September 30). *An Analysis on Indicators of Water Taxi User Service in Seoul Using Importance Performance Analysis (IPA)*. KSCE Journal of Civil and Environmental Engineering Research. Volume 29, Issue 5D (pp. 587-595). <https://koreascience.kr/article/JAKO200930265651350.pdf>
- Kizielewicz, J., Haahti, A., Lukovic, T. & Gracan, D. (2017, June 10). *The segmentation of the demand for ferry travel a case study of Stena Line*. Economic Research. Volume 30, Issue 1 (pp. 1003-1020). <https://doi.org/10.1080/1331677X.2017.1314789>
- Klijn F., Asselman, N. & Wagenaar, D. (2018, June). *Room for Rivers: Risk Reduction by Enhancing the Flood Conveyance Capacity of The Netherlands' Large Rivers*. Geosciences. <http://dx.doi.org/10.3390/geosciences8060224>
- Knoope, M., Faber, R. & Francke, J. (2022, May). *Trendprognose wegverkeer 2022-2027*. KiM. https://www.kimnet.nl/binaries/kimnet/documenten/notities/2022/05/30/trendprognose-wegverkeer-2022-2027/KiM+Trendprognose+wegverkeer+2022-2027_definitief.pdf
- Kouwenhoven, M., Rohr, C., Miller, S. & Daly, A (2006). *Evaluating a replacement ferry for the Isles of Scilly using a discrete model framework*. European Transport Conference (ETC). <https://significance.nl/wp-content/uploads/2019/03/2006-MKO-Evaluating-a-replacement-ferry-for-the-Isles-of-Scilly-using-a-discrete-choice-model-framework.pdf>
- Lai, M.F. & Lo, H.K. (2004, May). *Ferry service network design: optimal fleet size, routing, and scheduling*. Transportation Research Part A: Policy and Practice. Volume 38, Issue 4 (pp. 305-328). <https://doi.org/10.1016/j.tra.2003.08.003>
- Laird, J.J. (2012). *Valuing the quality of strategic ferry services to remote communities*. Transportation Business & Management. Volume 4 (pp. 97-103). <https://doi.org/10.1016/j.rtbm.2012.06.013>
- Lau, Y., Tam, K. & Ng A.K.Y. (2022, January). *Ferry services and the community development of peripheral island areas in Hong Kong: Evidence from Cheung Chau*. Island Studies Journal. <http://dx.doi.org/10.24043/isj.402>
- Lawson, C.T. & Weisbrod R.E. (2005). *Ferry Transport: The Realm of Responsibility for Ferry Disasters in Developing Nations*. Journal of Public Transportation. Volume 8, Issue 4 (pp. 17-31). <http://doi.org/10.5038/2375-0901.8.4.2>
- Lee, H. Y., & Leung, K. Y. K. (2022). *Island ferry travel during COVID-19: Charting the recovery of local tourism in Hong Kong*. Current Issues in Tourism. Volume 25, Issue 1 (pp. 76-93). <https://doi.org/10.1080/13683500.2021.1911964>
- Lohmann, G. & Pearce, D.G. (2012, February). *Tourism and Transport Relationships: The Suppliers' Perspective in Gateway Destinations in New Zealand*. Asia Pacific Journal of Tourism Research. Volume 17, Issue 1 (pp. 14-29). <http://dx.doi.org/10.1080/10941665.2011.613211>
- Luis, J.A.H. (2002, September). *Temporal accessibility in archipelagos: inter-island shipping in the Canary Islands*. Journal of Transport Geography. Volume 10, Issue 3 (pp. 231-239). [https://doi.org/10.1016/S0966-6923\(02\)00014-5](https://doi.org/10.1016/S0966-6923(02)00014-5)
- Mangan, J., Lalwani, C. & Gardner, B (2002, February). *Modelling port/ferry choice in RoRo freight transportation*. International Journal of Transport Management. Volume 1, Issue 1 (pp. 15-28). [http://dx.doi.org/10.1016/S1471-4051\(01\)00003-9](http://dx.doi.org/10.1016/S1471-4051(01)00003-9)
- Marta, L., George, R. & Evangella, S. (2021). *Applying the Island Transport Equivalent to the Greek Islands*. International Transport Forum.

- Mehta, C.R. & Patel, N.R. (2010). *IBM SPSS Exact Tests*. https://www.sussex.ac.uk/its/pdfs/SPSS_Exact_Tests_19.pdf.
- Memarian, A., Rosenberger, J.M., Mattingly, S.P., Williams, J.C. & Hashemi, H. (2019, August 26). *An optimization-based traffic diversion model during construction closures*. Computer Aided Civil and Infrastructure Engineering. Volume 34, Issue 12 (pp. 1087-1099). <https://doi.org/10.1111/mice.12491>
- Ministry of I&W (2022, March 17). *Spreiden en mijden*. Ministerie van Infrastructuur en Waterstaat. <https://www.crow.nl/downloads/pdf/mobiliteit/presentatie-marie-jose-oldekalter-17-03-2022.aspx>
- Mobycon (2017, February). *Veerverbinding Sleeuwijk Gorinchem Werkendam Hardinxveld*. Mobycon. Eindrapport. <https://docplayer.nl/60313602-Veerverbinding-sleeuwijk-gorinchem-werkendam-hardinxveld-eindrapport.html>
- New York City Ferry (2018). *Summer-2018-Survey-Results*. New York City Ferry. <https://www.ferry.nyc/reports-statistics/>
- Newsline Philippines (2017, March 25). *MARINA TO RORO: Follow ferry-ride rules, avoid overloading*. Newsline Philippines. <https://newsline.ph/top-stories/2017/03/25/marina-to-roro-follow-ferry-ride-rules-avoid-overloading/>
- Papaioannou, G., Polydoropoulou, A., Tsirimpa, A. & Pagoni, I. (2019). *Assessing the Potential of “Mobility as a Service” in Passenger Maritime Transport*. Freight Transport and Logistics. Volume 2. <https://doi.org/10.3389/ffutr.2021.710311>
- Peter, B. & Dawson, P. (2012). *P&O at 175 : a World of Ships and Shipping Since 1837*. Isle of Man: Ferry Publications, 2012.
- Polydoropoulou, A., Lagoudis, I. & Tsirimpaa, A. (2012). *Improving island competitiveness through alternative ferry connections*. Procedia - Social and Behavioural Sciences. Volume 48. <http://dx.doi.org/10.1016/j.sbspro.2012.06.1325>
- Poulsen, R.T. (2019). *Regional, yet Global: The Life Cycle of Overnight Ferry Shipping*. Shipping and Globalization in the Post-War Era (pp. 216-275).
- ProRail (2019, September 19). *Start veerdienst als alternatief voor defecte Calandbrug*. ProRail. <https://www.prorail.nl/nieuws/start-veerdienst-als-alternatief-voor-defecte-calandbrug>
- Quaife, M., Terris-Prestholt, F., Luca Di Tanna, G. & Vickerman, P. (2018, January 29). *How well do discrete choice experiments predict health choices? A systematic review and meta-analysis of external validity*. The European Journal of Health Economics. Volume 19 (pp. 1053–1066). <https://doi.org/10.1007/s10198-018-0954-6>
- Rahman, S., Wong, J. & Brakewood, C. (2017). *Use of Mobile Ticketing Data to Estimate an Origin–Destination Matrix for New York City Ferry Service*. Transportation Research Record Journal of the Transportation Research Board (pp. 1-9). <http://dx.doi.org/10.3141/2544-01>
- Rijkswaterstaat (2017). *Case study Deployment of a ferry at the Velsler tunnel*. Rijkswaterstaat. <https://rwsenvironment.eu/subjects/sustainable-mobility/toolbox-smart-mobility-management/bicycle/map/case-study-deployment-ferry-at-the-velser-tunnel/>
- Rijkswaterstaat (2019, January). *Samenvatting tracébesluit en saneringsbesluit Verbreding A27 Houten – Hooipolder*. Rijkswaterstaat. https://open.rws.nl/publish/pages/40454/rws_a27_houten-hooipolder-pvs_v2_dv.pdf
- Rijkswaterstaat (2022a). *Prognoserapport 2022 Vervanging en Renovatie*. Rijkswaterstaat. https://open.overheid.nl/documenten/ronl-4f136573fd73e0e65d504fd377e70e0eed77b_e3d/pdf

- Rijkswaterstaat (2022b). *Hinderaanpak: Slim plannen, slim bouwen en slim reizen*. Rijkswaterstaat. https://open.rws.nl/publish/pages/87793/20221222_werkwijzer_hinderaanpak_versie_2-0_2022.pdf
- Rijkswaterstaat (2022c). *A27: verbreding traject Houten – Hooipolder*. Rijkswaterstaat. <https://www.a27houtenhooipolder.nl/home/default.aspx>
- Rijkswaterstaat (2023a). *Snelweg A27*. Rijkswaterstaat. from <https://www.rijkswaterstaat.nl/wegen/wegenoverzicht/a27>
- Rijkswaterstaat (2023b). *Mobiliteitsmanagement tijdens de wegverbreding: minder drukte, minder hinder*. Rijkswaterstaat. <https://www.a27houtenhooipolder.nl/home/1998463.aspx>
- Riveer (2023a). *Vaarroutes*. Riveer. <https://www.riveer.nl/onze-vaarroutes/>
- Riveer (2023b). *Dienstregeling*. Riveer. <https://www.riveer.nl/wp-content/uploads/2022/06/Dienstregeling-Basis-website.pdf>
- SL (2023). *SL service network maps*. SL. <https://sl.se/en/in-english/getting-around/sl-service-network-maps>
- Soltani, A., Tanko, M., Burke, M. & Farid, R. (2016). *Travel Patterns of Urban Linear Ferry Passengers: Analysis of Smart Card Fare Data for Brisbane, Queensland, Australia*. Transportation Research Record: Journal of the Transportation Research Board. Volume 2535 (pp. 79-87). <http://dx.doi.org/10.3141/2535-09>.
- South Hams District Council (2008). *Dartmouth Lower Ferry*. South Hams District Council. <https://www.southhams.gov.uk/dartmouthlowerferry>
- Star Ferry (2023). *4th Generation Star Ferry*. Star Ferry. <https://www.starferry.com.hk/en/GalleryDisplay#ferries>
- Staten Island Ferry (2023). *Staten Island Ferry About*. New York City Department of Transportation. <https://www.nyc.gov/html/dot/html/ferrybus/ferry-facts.shtml>
- Stena Line (2019). *Annual Review 2018 Stena AB*. Stena AB. https://stena.com/app/uploads/2020/05/Stena_AnnualReview_190426_ENG.pdf
- Tanko, M. & Burke, M. (2015). *Innovation and transport planning: introducing urban linear ferries in Brisbane*. State of Australian Cities Conference Proceedings 2015. Urban Research Program, Griffith University.
- Tanko, M. & Burke, M. (2016). *Transport innovations and their effect on cities: the emergence of urban linear ferries worldwide*. Transportation Research Procedia. Volume 25 (pp. 3957-3970). <https://doi.org/10.1016/j.trpro.2017.05.483>
- Tanko, M., Burke, M. & Cheemakurthy, H. (2018, June 27). *Water Transit and Ferry-Oriented Development in Sweden: Comparisons with System Trends in Australia*. Transportation Research Record: Journal of the Transportation Research Board. Volume 2672, Issue 8. <https://doi.org/10.1177/0361198118782275>
- Tanko, M., Cheemakurthy, H., Hall Kihl, S. & Garne, K. (2019). *Water transit passenger perceptions and planning factors: A Swedish perspective*. Travel Behaviour and Society (pp. 23-30). <http://dx.doi.org/10.1016/j.tbs.2019.02.002>
- Task Force on Water-land Interface (2012, February 21). *Waterborne Passenger Transportation on Victoria Harbour*. Task Force on Water-land Interface. http://www.hfc.org.hk/en/task_forces/water_land_interface/meeting_20120221.htm
- Utomo, D.M. & Mateo-Babiano, I. (2015). *Exploring Indigeneity of Inland Waterway Transport (IWT) in Asia: Case studies of Thailand, Vietnam, the Philippines, and Indonesia*. Journal of the Eastern Asia Society for Transportation Studies.

- Van Berkel, T.J. (2020). *Reducing travel time within urban areas with water taxi networks*. TU Delft. <https://repository.tudelft.nl/islandora/object/uuid:8d15f145-3c7e-45c7-86df-0f2dd102e5b9/datastream/OBJ/download>
- Viney, R., Lancsar, E. & Louviere, J. (2002). *Discrete choice experiments to measure consumer preferences for health and healthcare*. Expert Review of Pharmacoeconomics & Outcomes Research. Volume 2, Issue 4 (pp. 319-326). <https://doi.org/10.1586/14737167.2.4.319>
- Vreeswijk, J.D., Rahka, H., Van Berkum, E.C. & Van Arem, B. (2015). *Analysis of inertial choice behaviour based expected and experienced savings from a real-world route choice experiment*. Universiteit Twente. https://ris.utwente.nl/ws/portalfiles/portal/5520596/vreeswijk_jaap_2014.pdf
- Wang, D.Z.W. & Lo, H.K. (2008). *Multi-fleet ferry service network design with passenger preferences for differential services*. Transportation Research Part B: Methodological. Volume 42, Issue 9 (pp. 798-822). <https://doi.org/10.1016/j.trb.2008.01.008>
- Watertaxi Rotterdam (2023). *Rondvaarten*. Watertaxi Rotterdam. <https://www.watertaxirotterdam.nl/rondvaarten>
- Waxholmsbolaget (2021, June 8). *Skärgårdsbåtar Ferry Network Map*. Waxholmsbolaget. <https://waxholmsbolaget.se/globalassets/kartor/hela-skargarden/linjekarta-skargarden.pdf>
- Weisbrod, R. E. & Lawson, C.T. (2003). *Ferry systems: Planning for the revitalization of U.S. cities*. Journal of Urban Technology. Volume 10, Issue 2 (pp. 47–68).
- XTNT (2023a). *XTNT*. XTNT. <https://xtnt.nl/>
- XTNT (2023b). *Werkgeversbenadering Brabant Mobiliteitsnetwerk*. XTNT. <https://xtnt.nl/project/werkgeversbenadering-brabant-mobiliteitsnetwerk/>
- Zuid-Holland Bereikbaar (2021). *Werkplan 2022-2024*. Zuid-Holland Bereikbaar. <https://zuidhollandbereikbaar.nl/wp-content/uploads/2022/01/Zuid-Holland-Bereikbaar-Werkplan-2022%E2%80%932024.pdf>
- 2GO Group (2021). *2020 Annual Financial & Sustainability Report*. 2GO Group. <https://www.2go.com.ph/wp-content/uploads/2021/04/2GO-Annual-Report-2020-and-Sustainability-Report-2020.pdf>
- 2GO Travel (2023). *Online booking*. 2GO Travel. <https://travel.2go.com.ph/>

Appendixes

APPENDIX 1 QUALITATIVE SSI FORMAT

#	Subject	Questions
-	Introduction	<p><i>Explain reasons for the interview and introduce thesis:</i></p> <ul style="list-style-type: none"> • <i>Master Thesis topic</i> • <i>Personal background</i> • <i>Introduce interview and interview subjects</i>
1	Background	<ul style="list-style-type: none"> • Can you briefly explain your professional background? • Can you briefly explain how you are involved with BMN? • How would you describe your role for BMN?
2	BMN	<ul style="list-style-type: none"> • What is the role of BMN in the province of North Brabant? • What are the goals of BMN? What are subgoals of BMN? • How does BMN attempt to reach its goals? • What progression has been made over the years? What were notable key moments during these years?
3	A27	<ul style="list-style-type: none"> • How is BMN involved in the project (started by RWS) on the A27? • How has the cooperation between RWS and BMN been constructed? • What is the goal for BMN for this particular project? • How does BMN attempt to reach that goal?
4	Communities	<ul style="list-style-type: none"> • What communities have been set up for the A27? • How successful have these communities been? • What problems do employers still expect when looking at the project? • What have the communities been offered in terms of helps to remain accessible during periods of hindrance?
5	Mobility management	<ul style="list-style-type: none"> • What hindrance is expected during reconstruction of the A27 and in particular the Merwedeburg? • What alternatives in routes does BMN support, if it supports any at all? • What travel alternatives are available? • How does BMN include these alternatives in their mobility management? Is there a best to worst alternatives list? • Where does travel over water rank as an alternative? • How do you estimate the viability of travel over water as alternative?
-		<ul style="list-style-type: none"> • Do you have questions regarding the interview or the research?
-		<p>End of interview. After the interview the interviewees will be given insight in the next steps that will be taken during the research and will be told how the information given will benefit the research. Any questions or further actions that cannot be answered or take place during the interviews will be taken into account after the interviews.</p>

APPENDIX 2 INTERVIEW ANALYSIS

The interview conducted was recording on Teams on March 7th 2023 and a transcript has been made in order to make analysis of the interview possible. The transcript can be found below. A semi-structured interview was used, as there were already several different interesting predefined subjects resulting from the background research. These subjects also directly function as the predefined set of codes used for the deductive coding of the interview. The deductive coding has been visualised using different colours and is used for chapter 2 of this research.

#	Subject	Questions
-	Introduction	<i>An introduction on the thesis topic was given. Because interviewer and interviewees already knew each other personally, the introduction was aimed at explaining what the aim of this interview was and what subjects would be taken into consideration during the semi-structured interview.</i>
1	Background	<p>Ilse van Zijl is an employee of the consultancy XTNT who has been part of BMN for several months now. At XTNT, Ilse is a senior employee and is specifically skilled when it comes to mobility transitions and participation projects. At BMN, Ilse is a community manager for the area around the A27 and is in charge of the approach of BMN and the cooperation between BMN and RWS in this area.</p> <p>Ingeborg Haers is colleague of Ilse at both XTNT and BMN. Ingeborg joined XTNT over a year ago after finishing her master and is currently a junior advisor. At BMN, Ingeborg is specialized in the analysis of employers. This analysis is aimed at determining what can be done to support sustainable mobility at employers. Ilse and Ingeborg works as a team to help employers in the region.</p>
2	BMN	<p>Ingeborg: It is quite difficult to explain what BMN does in short. The three terms we often identify with are 'inspire, connect and advice'. This is the core of what we do. By many others, BMN is seen as an employers approach. This is correct as well, but simply an employers approach does not do justice to all the stuff that is done at BMN. When we look at our approach to reaching more sustainable mobility at employers, there are different steps. Firstly, we look at the ambitions of employers. We use a 'mobility index' to determine this. After that, we analyse the opportunities with a postal code scan and a survey among employees. The last two steps involve determining what the actual measures will be and then implementing those measures at a company.</p> <p>Ilse: BMN was started by the province in order to reach employers and help them with sustainable mobility. We use the employers approach to do so, because we can help individual employers to look at more sustainable options this way. The first step is therefore very important, as it helps us to understand what the ambitions of employers are. We can connect with these ambitions and inspire or advice these employers with ideas that really help them reach their ambitions. And on top of that, we do not only focus on employers, but also work together with knowledge institutions, educational institutions, municipalities and other partners. Using our network to connect these employers and institutions is another strength of BMN, as we know where certain knowledge can be found and how it can be used.</p>

3	A27	<p>Ilse: The A27 was not originally a focus point of BMN, as BMN started ten years ago and the reconstruction of the A27 was not a factor back then. However, at this moment the A27 is a point of concern for the region. BMN was approached by RWS with the question to expand and intensify activities around the A27. This means we now focus extra on three specific communities in Altena, Geertruidenberg and Oosterhout. We use the A27 as an external cause that employers can use to change towards more sustainable mobility. BMN is expected to at least reach out to a certain number of employers in the region over the next years. RWS and BMN look at the results together every three months and more in-depth every six months. New trends or opportunities which arise during these moments of feedback can then be further examined by BMN or RWS.</p> <p>Ingeborg: The area around the A27 has its own difficulties. For example, public transport is not very accessible in this region. As BMN, we can help employers on eight different subjects. Public transport is one of them, but together with RWS we decided not to focus on public transport in this particular region. Thus, this helps us to focus our approach. Eventually, we also need to report back to RWS what we have done in this region and, as part of cooperative approach, they will determine whether we have done a good enough job.</p>
4	Communities	<p>Ilse: In some of the communities we have, we have started talking with individual employers in the beginning. However, as we are supposed to do with our regional approach, we also like to look at what subregions can do together as a community. This can change, depending on the nature of the region we are talking about. Some regions already cooperate on a certain levels. There are some business parks for example that already work together on accessibility issues. We can use that cooperation as basis for our work. An important factor which often decides whether a cooperative approach is viable, is the location of the employers we are working together with. In Altena, for example, employers are not clustered. This means there is hardly any cooperation between employers at the moment and this means the approach of BMN has to be different. In this particular case, we decided to start working with 'leading companies': Companies that are willing to invest in this cause and can act as examples for other companies in the region.</p> <p>By doing this, we start building our own communities. With these communities, we look at what can be done separately and what can be done together. For example, carpooling or stimulating more cycling can be done on an overarching level. Of course, we also work together with the local municipalities to determine our approach, as municipalities often know where clusters of companies are located. In the municipality of Oosterhout, there were already five clusters of companies which had been identified, so as BMN we used that structure of clusters. In Altena and Geertruidenberg we did not have any structure yet, so we developed it on our own. In Altena, we were lucky, because we found out there was already an association between some businesses. We found out, approached them and had to determine how active that association was and how we could cooperate with them to boost our approach. These are all different examples of how our approach can change based on the information we receive and the situation 'on the street'.</p>

		<p>Ingeborg: When we know how to approach the employers or the associations in the area. We can also start to determine on what themes of mobility we want to cooperate with them. As we already mentioned, public transport is one of the eight themes we use to work on more sustainable mobility. Around the A27, public transport is not seen as a useful alternative for many employees, which leaves us with seven possible themes. To determine what themes we can use in a specific area, we look at the ambitions of the employers and determine what themes can be beneficial for their ambitions. The most important themes are cycling stimulation, working from home, changes in behaviour and improving communication. However, it is often hard to directly link these themes to ambitions. Employers often do not have ambitions in terms of mobility. Therefore, we link the themes to other ambitions within the company, such as increasing sustainability, vitality, accessibility. On top of that, employers now more often have to deal with a lack of employees. Our ideas can help to give them an advantage over other companies. We use the postal code scan, survey and other tools to do so. Of course, this can be done both on individual level, business park level and community level as well. In the end, the role of BMN gradually decreases and the role of the employer itself increases. As BMN, we provide inspiration and advice in early stages, but we cannot provide endless economic impulses. The company eventually has to take its responsibility. As BMN, we then keep the community together so that they can keep inspiring each other. Of course, we also stay connected to individual employers and can help them when they want to.</p>
5	<p>Mobility management</p>	<p>Ilse: We know that the project on the A27 will have severe effects on the road network in the region. This does not only mean the A27 itself will have problems dealing with traffic, but will eventually also mean the underlying, local road network will have to face the negative effects. We can use the tools provided by RWS to look at the intensities of traffic at different times of the day. On a normal day, RWS expects that traffic will be delayed by an average of 20 minutes. Of course, when you travel to work and back home you encounter traffic twice and thus end up being on the road around 40 minutes more than you would normally be. However, because RWS is currently still working on the research and planning, we do not exactly know how problematic the situation will be. As BMN we do not provide any information on alternative routes, as this will not solve any problems. However, we also already mentioned public transport is not an alternative here. We know that the average distance to a train station is relatively high on this area for example, which makes it hard for us to stimulate travelling with public transport. Therefore, stimulation cycling is one of our most important alternatives.</p> <p>Ingeborg: Travel over water has been looked at as an alternative. RWS has also looked at this option and the possibilities to use extra boats on top of existing routes. However, it is very hard for BMN to use travel over water as an alternative. We do not know for who this might be a viable alternative. Knowing this would mean we can actually use it as an alternative in our community based work.</p>

End of project team interview. No questions were asked by the project team, although both sides requested to remain in contact during the master thesis period and share the results of the thesis.

APPENDIX 3 OBSERVATIONS

To understand the activities of BMN even better of the SSI, several observations of conversations between BMN and employers in the region will further determine how BMN aims to mitigate the hindrance, what problems employers are still facing and what factors travel over water can respond to as a solution. Three observations of conversations between BMN and employers were conducted. A transcript of the conversations have been made. Coding of the observations will be similar to coding of the SSI, using the same predetermined set of codes and thus also using deductive coding again:

Background	BMN	A27	Communities	Mobility Management
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Company names and individual names have been left out due to privacy reasons. This was a conscious choice, as the observations were only used to create a general image of the situation, independent of the employers. On top of that, including names might also have implications based on the General Data Protection Regulation (GDPR).

Observation 1: Business park

The first observation concerns BMN and the first meeting with the management of a business park in one of their communities and took place on March 27th 2023. Attending:

- Ilse van Zijl, community manager at BMN
- Ingeborg Haers, analyst at BMN
- Chairman of business park
- Accountant of business park

Van Zijl: It is the first time we meet, so perhaps we can start with our reason to initiate this conversation in the first place. Ingeborg and myself are both part of BMN. You have probably already heard that the highway A27, which is very close to your location, will be reconstructed in the near future. We expect a lot of hindrance as a result of this reconstruction and therefore want to inform you about it, but also want to give you opportunity to act appropriately as an employer. We want employers and employees to be prepared for what is coming in terms of hindrance, which is why we initiate these meeting. Several other business parks have already been involved in this approach, so that is why we now also want to approach you. As the communitymanager from BMN, I have a leading role in this approach. Ingeborg is the second person in our team and focuses more on the analysis of the different employers and business parks. Today we want to see what BMN can mean for you.

Accountant: The managing board of this business park are the roles fulfilled by the chairman and accountant of the owners' association. Both the chairman and accountant therefore are employed at particular companies on the business park, but fulfil a role for the overarching owners' association. The association sadly lost one of their members recently. A new member for the association has been found and we now seek further possibilities to improve the business park.

Chairman: The park exists of a total of 24 buildings, but some of the buildings provide a location for multiple employers. As owners' association, we primarily help in terms of improving accessibility and safety, but also organise maintenance on the business park. We still need more engagement from our employers. As we are located almost on top

of the A27, we are directly involved in the hindrance resulting from reconstruction. We do not like the hindrance, but I think that we all need that it is absolutely necessary to change this road for the better. Perhaps widening the road is the only solution to stop the congestion

Van Zijl: Although widening the road is certainly an option, we also know that adding more tarmac is not going to solve all the problems we face. With our employers approach, we want to look further than travelling on the A27. We also want to look at travelling with other modalities, or even with multiple modalities to complete a trip.

Haers: We use analysis to determine what can be successful in your particular case. And to add to Ilse, as a psychologist, I can look at your problems and the behaviour of the employees from a psychological perspective. This can also help to determine if cycling or even travel over water can be an opportunity for your employees.

Accountant: Travelling differently is certainly an opportunity. Cycling is something which is stimulated already. However, travelling over water is another one to keep in mind. In the past, we used a small ferry in this region when any bridges were closed. I do not know if this is a possibility here as well. We do know that students in this region used the small ferry which we still have for pedestrians and cyclists. They reach their schools on the other side of the river with this ferry. This might be an important opportunity for us as well.

Van Zijl: Indeed. What we know at the moment is available on the project website of RWS. This includes all the activities on the A27, we spans more than just your region. In your region, preparations have started and the real construction work will start in the next years. An exact date is not available, but by the end of 2023 reconstruction will have started, which will last until 2029 or possibly even 2031. Of course, RWS looks at how they can use clever solutions in terms of planning. Hopefully, a lot of the hindrance in this region can be mitigated by working during holidays, weekends or during the night. We can also use temporary bridges in some locations to at least keep the region accessible. Even though we work hard to mitigate the hindrance, we still expect around 20 minutes of delay per direction. That is also a reason for us to be here today, as we know that we have to anticipate now. If we wait until 2024, we know we will be too late and congestion will hit record heights. We will try to find solutions with you to help you stay accessible.

Accountant: Cycling was stimulated over the years, but when the weather is bad the parking lot will always be full of cars again. Because there is already a lot of congestion and this will increase during construction, cycling does become a more interesting opportunity. We do have to look at what would make cycling more interesting for our employees. And we also have to look at what we can do as business altogether.

Chairman: An external company is currently doing research in our neighbourhood and also looks at mobility and sustainability. They also look at how cycling lanes are designed in this area and what can be improved. Most companies have their own parking lot with some place for bicycles. However, how bicycles are facilitated is really up to the employer. This same goes for charging electric bicycles, but also for electric cars.

Van Zijl: So the owners' association does not have guidelines or ideas about how to improve the situation now?

Both: Not really, but the A27 will be a concern for the employers, employees and customers. This will provide an external cause to improve the situation.

Haers: BMN can help you with that. We have communities that can help each other forward. As BMN, we inspire, connect and advice. This helps creating sustainable solutions for mobility. After this kick-off, we would like to analyse the situation with our different tools. Eventually, we look at the ambitions of employers or the business park and decide what opportunities you have to improve the situation. All of our input and time will be completely facilitated by BMN, which means it will be free for you. Of course, we have to determine whether to target you as a business park or to target individual employers on your park.

Accountant: It would be better and easier if we would set this up for the business park collectively. We already have a team that tries to increase the health of our employees. Mobility can certainly be a part of this ambition. I know that, at the company where I work, we know that legislation will change in the near future and that we will have to report about mobility better as well in the future. I cannot imagine other companies will not think about this the same. However, we do have to check this with our employers first. Would it be possible for you to explain more about the situation?

Chairman: Accessibility is one of the aspects the owners' association want to look at. As we have 24 buildings and even more employers, I think there will be more than enough employers that will be interested in your story. If we can share cars or bicycles together, set-up a system that improves carpooling or stimulate working from home more, I think we can make a lot of impact together. But we would have to look at the vantage point of all different companies and would have to try to bring them together. We can give you the opportunity to tell more at our next meeting?

Van Zijl: Of course we can look at the business park on an overarching level. There are a lot of themes on which we can do something collectively.

Chairman: May 9th is the next meeting with the employers. We can tell the employers in advance that the A27 will be reconstructed and that you will be here to talk about sustainable solutions for our problems, that will get their attention. Our new member of the association will also be very pleased with your ideas.

Accountant: It will be important to let all the employers know it will be a problem between 2023 and perhaps even 2031. They will listen carefully to you when we mention the hindrance will be increased for years to come.

Van Zijl: We would love to attend the meeting and we can also ask RWS to illustrate in detail what will be done on the A27. This will also trigger employers to come to this meeting. If you will send the invite to me, I will make sure we are present at the meeting and will ask RWS to come as well.

Ending of conversation after all present have thanked each other for their efforts.

Observation 2: Employer (leading company)

The second observation concerns BMN and the second meeting with the managing board of a leading company in one of their communities and took place on March 14th 2023. Attending:

- Ilse van Zijl, community manager at BMN
- Ingeborg Haers, analyst at BMN
- Managing board, employer
- Managing board, employer

Van Zijl: Good to see you again. Last time we met, we talked about BMN and what we could do for you with our employers approach. We also started with the analysis of the company and completed the postal code scan. We can now look at the specifics of your company and determine what aspects we want to focus on.

Haers: We know the hindrance at the A27 is going to affect you as an employer. When we look at recruitment, we know the hindrance can be problematic for future employees. We want to help you forward and discuss whether you want to be one of the leading companies for the community in Altena.

Board: Since the last time we met, we have followed some of the online-sessions of the municipality and have had recent exchanges of information about the project on the A27. It would be promising to meet with employers within the community once again to talk about the possibilities we have. For example, we now suggest that everyone in this region works between 8 am and 5 pm. However, we as a company do not produce anything locally, so we could change the working times of employees or give them the opportunity to be more flexible. We wonder what that would be like for other employers. Cycling stimulation will not have a great effect here I think. But can RWS come up with other solution as well? On the A9 they could keep open several lanes while working on the road. I think keeping lanes open is of vital importance and crucial for the accessibility of the region.

Van Zijl: It is indeed true that it would be great to keep lanes open at all times, but even though we try to plan everything as smart as we can, there is simply no way we can keep lanes open at all times. There have to be moments we need to limit traffic there, otherwise the reconstruction cannot take place. This will also mean that on dedicated moments, we will have to shut down the entire highway. We know it is very difficult to keep accessible during those periods, but there is nothing we can do about it. Because RWS is still planning, it is not possible to exactly determine how long certain closures will last. The planning will be available later this year. RWS does know that it will take between 10 and 30 minutes longer than now to travel on the A27 in this region. This is also the case for the underlying road network. We know that this message is quite harsh, but we cannot change it unfortunately. We can only help you to stay accessible using other tools that we provide. Looking at your particular company, I do agree that cycling might not be the best option. There are more options however. We do agree that it is very valuable to work together with other employers.

Haers: Cycling is only one of the eight themes that we use to improve sustainable transport at employees. If we think cycling is not an option for you, we can always look at your ambitions and determine what other themes can be used for your particular case. Also we can do this for multiple companies in once as well.

Board: We already did the postal scan twice, but the advices we received from the postal scan are difficult for us to understand. Our company is aimed at providing a service. We have a specific group of around 50 employees at our office. Other employees might be on the road or at our clients. We received some advice on public transport, but we know public transport in this region is not good enough to function as an alternative. As managing board, we can completely fill in the survey for employees ourselves, because we already know every employee and their specific story. Our location is simply a bit more problematic than the average location. Cycling is not really an option. We have so far only helped one employee with our cycling stimulation. We know that cycling through the polders in our region with hard winds is very different and it will not help our cause. Working from home is also quite difficult for some of our employees. Therefore, the advices we received do not really fit the company. However, our neighbours do have a production location and it is possible that they receive valuable information from this scan and the survey.

Van Zijl: As I understood it last time, many of your employees use vehicles from the company and travel between your clients and the office. They also use the A27 for their journey. Do you feel our advice do not match their possibilities? And where do you feel the need to work on?

Board: Because we need to reach our clients, many of our employees simply cannot use another form of transport and are bound to the vehicle of the company. We do not catch these trips in the postal code scan. If we want to make a thorough analysis. I suggest we make it ourselves. We can then also leave out public transport as an option for example, because the nearest bus station is around 30 minutes walking away. Other solutions which might benefit us, are not currently in the scan. For example, instead of returning to the company to pick up materials, we could also have one person do a night shift in which he drives past all company vehicles, which will be parked at the house of employees in the night. He can then refill the vehicles, which means the other employees do not have to go to the company location in the morning or evening. But this is not a solution you can use in any other place probably. We would love to think about these kinds of solutions together with you, and what we are doing now is already very valuable, but we are simply not one of the typical companies.

Van Zijl: That is good to hear. And of course, what we could do is focus on the 50 employees that work at the company location. Your mobility policies do leave room for improvement for them. Working from home and spreading traffic over different times of the day can be important for you as well. On top of that, we know that we can help with changing behaviour and communicating successfully, so if we can help you on those aspects that would be interesting as well.

Board: If we would have seen any quick-wins on those aspects, we would have already implemented them. Many of our employees have to come to the office because their computer is here for example. Not all of them can work from home with laptops. We need to look at those specifics as well. And the employees who have their own office here sometimes also come here on their bicycles or even by running to the office. However, some of them are representatives and they need their car for their work.

- Haers: Car sharing can also be a solution in this case.
- Board: The employees use their car also in their private life. They first bring their children to school for example and then drive here. They will not switch to car sharing. We do think about these solutions, but implementing them is harder imagined. We would like to discuss these ideas with other companies to look at their ideas.
- Van Zijl: We can try to connect you to companies that are quite similar. We can then try to think of collective measures to improve the situation. When we think on an overarching level, it is often easier to set up measures.
- Board: Along the A27 know that many different employers and organisations are involved in this process. Lets work together as much as possible and learn from each other instead of reinventing the same ideas over and over.
- Van Zijl: On April 20th in the morning we will present the first results of different scans and the approaches to different regions. We would like you to join that meeting and stress the need to work together. After that, we can start connecting you with the best companies.

After agreeing to this proposal, all people attending thank each other and conclude they will see each other again on April 20th.

Observation 3: Municipality (fourth meeting)

The third observation concerns BMN and employees of a municipality in one of their communities, with which they have had regular contact already and took place on March 22nd 2023. Attending:

- Ilse van Zijl, community manager at BMN
- Ingeborg Haers, analyst at BMN
- Policy Officer (Sustainability), municipality
- HR-advisor, municipality

- Van Zijl: We have spoken before about the employers approach in your region and the fact that the municipality want to act as an example by being an active employer as well. Of course, we know that the A27 will be reconstructed and that this will cause a lot of hindrance in the region. On February 7th, we spoke about the results of the postal code scan and the mobility index. We also discussed the ambitions of the municipality on sustainability, mobility, accessibility and vitality. We then also discussed how the survey amongst employees could give us more insights into the thoughts of your employees on new forms of mobility, or other sustainable solution. We ended that meeting agreeing that you would internally discuss if the survey could be set out.
- HR-advisor: We talked about this with the policy officers for sustainability and mobility. We also discussed the postal code scan. However, we do have some drawbacks. In the past years we already made several attempts to change towards more sustainable transport. Back then, we eventually did not receive enough support by the alderman which meant everything we did was eventually turned down. In this case, we want to start by convincing the managing board and the alderman that this is actually something worth investing in. We know certain parts of the approach fit within the policies we

have at the municipality, but we need to know if this approach can count on the support of the board and the alderman. With the **A27 and the hindrance** that is expected, we know there is an **external reason to pay extra attention**. We have discussed this already with our board, but they mentioned that **extra initiatives are not part of the political agreements**. Of course, certain parts will be as we have goals in vitality and sustainability that we can use, but for example setting up **cycling stimulation is not something we can do based on the current agreements**. Of course, the policy officer of mobility thought of that differently. He thought the municipality should be **one of the examples for other employers**. These internal struggles make it difficult for us.

Policy off.: We don't want to do nothing. There are certain steps we must take, but we simply want to **approach our board and the alderman first** to make sure we have their support. We have to **determine what the goal is and where our focus lies**. Eventually, we can take several smaller steps or immediately take large steps. For example, new agreements on working from home could mean a large step for us. We want to **contribute to more sustainable mobility**, but probably **without having to invest too much in advance**. When we **set out the survey** amongst employees now, we **create certain expectations**. People expect us to do something with the results of the survey. We cannot do that until we know for sure we can actually make those changes and have support of the alderman.

Van Zijl: Of course, we support your ideas to first explore the priorities and then take action. On the other hand, **mobility is never a goal** on itself. It is always a means to reach other goals in terms of sustainability or vitality. You might wonder whether any of the things we do should be in the political agreements. I think all the measures we take are part of the agreements, as they are measures with which certain goals described in these agreements are met. The **ambitions and targets of the municipality** are very progressive, you really want to **be a leading employer** on this theme. With our approach we want other employers to take action as well. As you already mentioned, the **A27 is an external cause** we use to speed this process up. Of course, when you actually want to take a leading role, we understand that the alderman have to support this.

HR-advisor: We really want to be progressive and we would absolutely like to **do something with your approach**. At the same time, we think your approach comes too early for many of our political agreements. In these agreements, we describe **overarching goals and ambitions**. We first have to work out how we are going to reach those goals and ambitions. If we start participating in the employers approach now, it feels like we have already started working on something without understanding what it can eventually actually mean for us. That would mean the effect could be barely noticeable afterwards. **This approach should be framed more logically** on the timeline.

Policy off.: We can look at the results we can achieve by taking smaller steps. As BMN, you know with **what steps we could start** to at least remain active on this theme. But as long as the framework is not available, it would **be hard for the municipality to go all-the-way**.

Van Zijl: If the alderman do not feel any urgency, I agree it will be hard to take a big step. Eventually you will make that step, but it might take longer in this case. Of course, we know what smaller steps are available for the municipality and know how to

achieve quick-wins. However, we would like to combine that with our approach on long-term goals. For example, people know how extensive cycling stimulation can be, but with some unique, playful actions, we can still deliver our message to the employees.

Haers: Of course, we would like to help you with these playful, short-term actions that deliver quick-wins. But as Ilse said, it is important to connect these quick-wins with long-term goals and ambitions. And on top of that, you can work together with other employers on quick-wins as well.

HR-advisor: If you have any examples of those actions or measures that contribute to sustainability and vitality we can discuss these with the alderman to show him the steps we could take. This can include cycling, walking or challenges for other kinds of transportation as well.

Van Zijl: We have examples of actions in which the management of companies sacrificed their parking spots in order to stimulate carpooling or cycling. Those actions are relatively accessible, but do cause commotion amongst the employees.

HR-advisor: We can use those. This also makes it possible for us to contribute to mitigate hindrance on the A27. We have to try and find out who can travel with an alternative. In the conversation with the alderman we can use the quick-wins as examples to try and win his commitment.

Haers: My only concern is that fact that giving these quick-wins as examples already sets the bar. I think the vantage point in the conversation with the alderman should be the overarching, intensive approach. If he does not want to commit to that approach, you can give the examples of quick-wins and set those as a minimal commitment for the municipality. Depending on the results of your conversation, we can look at the results of the postal code scan and the mobility index. We can then also determine of the survey will be set out. And on top of that, we should also look at the possibilities to include the municipality in the community, as we can then communicate with each other and our employees on overarching levels.

Policy off.: Do we need to contact those companies?

Haers: We work with leading companies, which are employers that have already taken some steps towards more sustainable mobility. They can help other employers forward. On April 20th, we organise a meeting with RWS to discuss what can be done on overarching level and what can be done separately. During that meeting, we also discuss the opportunity to divide the community into separate areas if necessary. All employers have been invited to participate, possibly also with their HR-advisors. We would like you to participate as well.

After agreeing to join the meeting, BMN and the municipality make another appointment on April 18th. This is exactly one day after the policy officer and HR-advisor will discuss the ideas of BMN with the alderman. The conversation is ended directly afterwards.

APPENDIX 4 SURVEY

Screenshots from a translated version of the survey taken from the online survey system Survio



Travel over Water

Dear respondent,

Thank you for opening this survey. As a senior student at the University of Hasselt I am currently working on my Master Thesis. On behalf of the consultancy of XTNT, I conduct research into 'Travel over Water'. By sharing your opinion, you can help us understand whether travel over water can be used as an alternative mode of transportation during road construction in the future.

Participation in the survey is completely voluntarily and will take around five minutes. All answerd will be kept anonymous.

If you have any questions about the survey in particular or the research in general, you can contact j.vanherpen@xtnt.nl. I really appreciate your input!

Jelmer van Herpen

[START SURVEY NOW](#)

The questions in this research focus on a single type of travel over water, which is the ferry. In this particular research we focus on a ferry within a local transportation network, for example a ferry which connects two villages or two boroughs on either side of a river.

1. What is your general opinion on using a ferry as a part of your journey?*

0	1	2	3	4	5	6	7	8	9	10	
Very negative											Very positive

2. Do you currently use a ferry in your trips or have you used a ferry before?*

Choose one answer in every row

	Yes, (almost) daily	Yes, (almost) weekly	Yes, (almost) monthly	Yes, less than once a month	No
I currently use a ferry	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have used a ferry in the past	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. For what kind of trip do you think the ferry would be an appropriate mode of transportation?*

Choose one answer in every row

	Never	Rarely	Sometimes	Often	Always
from/to work or school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
from/to shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
from/to family or friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
as part of a recreational trip	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Now and in the future, the road network in the Netherlands requires a lot of maintenance. Unfortunately, this means that we will be increasingly affected by traffic jams. To understand how we can anticipate to this worsening situation, I would like to ask you to imagine the following situation taking place:

You travel by car to work, school, family or to a shopping center. Unfortunately, the bridge you normally always travel on is temporarily closed due to maintenance. However, there is a ferry for pedestrians and cyclists in the area that you can use. You can therefore also leave your car and use the ferry to cover the last part of your journey or use the ferry as part of your journey by bike or foot. This shortens your travel time by about 20 minutes.

4. How probable is it that you would use a ferry as an alternative mode of transport during road maintenance?*

Choose one answer in every row

	Definitely not	Probably not	Probably	Definitely
from/to work or school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
from/to family/friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
from/to shops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
as part of a recreational trip	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Under what circumstances would you use the ferry?*

Choose one or more answers

If the ferry significantly reduces my total travel time

If the ferry takes me within walking distance of my destination

If the ferry is free or the costs are reimbursed

I would not use the ferry under any circumstances

Other...



6. What is your gender?*

Choose one answer

Male

Female

Other than the above

7. What is your age?*

Choose one answer

17 years or younger

18-24 years

25-64 years

65 years or older

8. Which of the following answers best describes your situation?*

Choose one answer

I am currently employed

I am currently a student/student

I am currently unemployed, looking for work or unfit for work

I am currently retired

Other...



9. Are you tied to a company car for your trip to work, such as a lease car or company bus?*

Choose one answer

Yes

No

10. How many times a week do you travel to your work or educational location on average?*

Choose one answer

Never

1-2 times per week

3-4 times per week

More than 4 times per week

11. What is the average distance you travel to your place of work or education?*

Choose one answer

Less than 7,5 km

Between 7,5 and 15 km

Between 15 and 30 km

More than 30 km

12. How many days a week do you travel on average with the following means of transport?*

Choose one answer in every rows

	0 days per week	1-2 days per week	3-6 days per week	more than 6 days per week
Car	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bicycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

By pressing the button below, your answers will be submitted. Thank you once again for your participation in this survey!

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