

The necessary parameters for the implementation of Mobility as a Service in Assen.

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Table of Content

Summary	3
Introduction.....	4
<i>Research Problem</i>	6
<i>Thesis structure</i>	7
Theoretical framework	8
Methodology.....	10
<i>Research Methods</i>	10
<i>Literature review</i>	10
<i>Coding</i>	10
Results.....	12
<i>Literature review</i>	12
<i>Case study: Assen</i>	13
<i>Interview data Analysis</i>	15
<i>MaaS definitions and understanding</i>	17
<i>Parameters</i>	17
<i>Scale</i>	18
<i>Involved Parties</i>	19
<i>(Passive) participation</i>	19
<i>Demand or Supply driven</i>	20
<i>Strategy</i>	20
<i>Conditions</i>	21
Conclusion	22
References.....	23
Appendices	26
1. <i>Interview guide (G1 & G2)</i>	26
2. <i>Interview Guide (E1 & E2)</i>	29
3. <i>Interview Guide I</i>	32
4. <i>Interview overview per topic</i>	35
5. <i>Word occurrence during interviews</i>	44

Summary

This thesis explores the necessary parameters for a MaaS scheme to thrive in the Netherlands. Firstly, numerous parameters are investigated of three successful, European MaaS projects; Hannover, Germany; Birmingham, England; Vienna, Austria. Secondly, the city of Assen is then taken as a case study. This city has been preparing to be a MaaS city for years; ever since the Sensor City project was completed. This study has a qualitative approach and was conducted by means of a literature research and semi-structured interviews.

The results show that population density is an important parameter for the implementation of MaaS in a city. Furthermore, an existing multi modal public transport system is vital for the transition to a MaaS system. It is not financially viable if all modes are yet to be introduced. However, network density is not a necessary parameter for a MaaS scheme. Low network density cities have proven to be able to implement successful MaaS schemes.

Assen does not fare well on both necessary parameters as it has a very low population density, the smallest population density within the literature review.

The existing modes in place for Assen are buses, trains and bike sharing. Meaning that there are three existing modes in place. Theoretically, this could be enough to build on.

One of the main issues with Assen is the communication of projects; the intentions and aims of projects are not clear for the inhabitants. Assen is included in the Groningen-Drenthe MaaS pilot, which is currently searching for a service provider. The service provider is responsible for advertising and communicating the project to the inhabitants. Furthermore, as Assen is part of a regional pilot it could have a better shot at being successful. Unfortunately, the regional population density is still rather low. There are not many comparable areas to the North of the Netherlands that have implemented a MaaS scheme, so it cannot be said with certainty whether it will or will not work.

One of Assen's advantages could be found in the recent societal changes that have occurred due to Covid-19. The traffic sensors situated throughout Assen would inform inhabitants of the quietest routes to take, helping them maintain a 1.5 metre distance at all times. With health at the forefront of people's minds, it might force people to actively look at their transport preferences.

Introduction

The following thesis is focussed on Mobility as a Service. This topic was chosen because the role of technology in everyday life is intriguing to me. The current day ‘symbiosis’ of technology and people is so engrained that it is hard to imagine something going wrong. That is why this thesis takes a closer look at examples of MaaS that worked, but more importantly, at one that did not. Personally, I find failures far more fascinating to study than successes.

Mobility as a Service (MaaS) is a relatively new way of providing transport within cities (Hensher et al., 2020). Theoretically it provides an overview of all transport modes available, additionally one can book and pay for a trip using the very same platform. This platform tends to be a digital app that is often used on a smartphone. Combining technology with urban life and transport within a city, often leads to said city being called a smart city. Although currently thought of as a buzzword, the concept

arguably dates back to 1922, when automated traffic lights were installed in Houston, Texas (Poole, 2014). However, a lot of steps have been taken since then. So what is considered a smart city nowadays and how does MaaS relate to the topic?

The smart city concept has been defined by the European Commission as diverse technologies helping in achieving sustainability in smart cities. Smart cities and communities focus on the intersection between energy, transport and ICT, which are also the fields that have received most of the EU's public smart cities related funding (under the Horizon 2020 program “smart cities and communities”)(European Commission, 2012). Smart City is an umbrella term that actually involves multiple layers, concepts and applications (see fig. 1) . Once a city applies one of these concepts, that city often brands itself as a Smart City (Geertman & de Klerk, 2016).

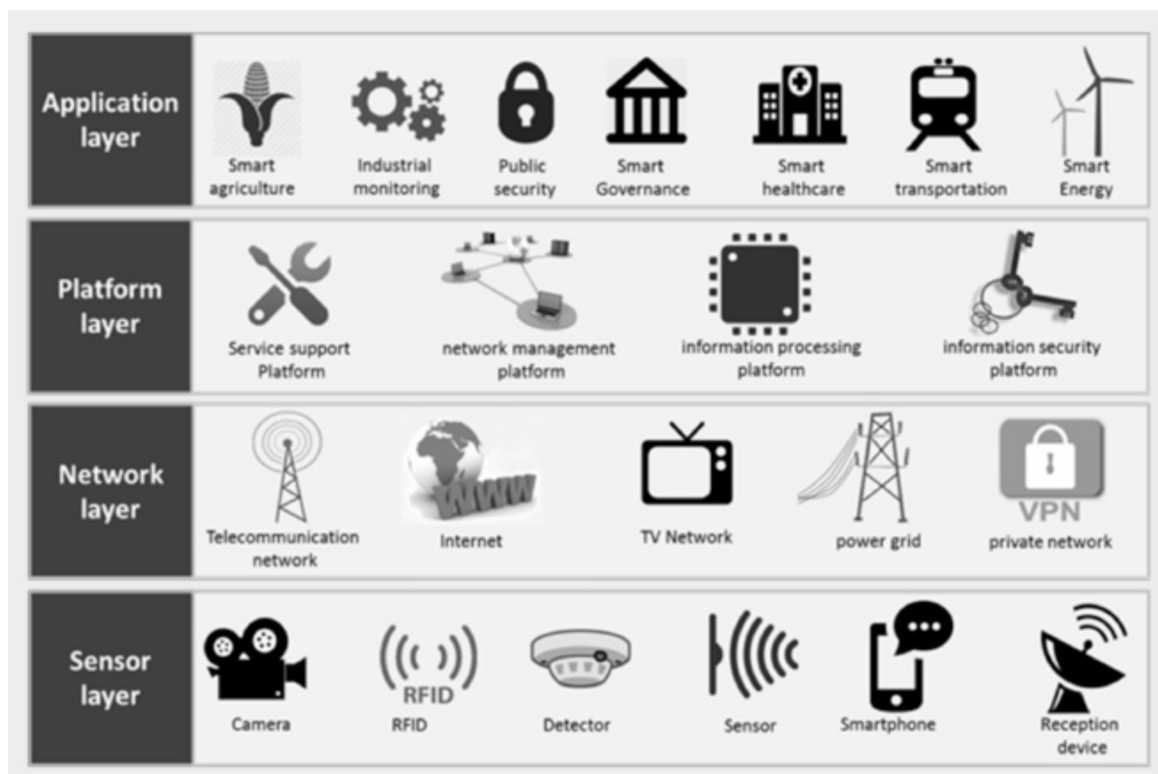


Fig. 1: Layers of a Smart City (Geertman & de Klerk, 2016).

F. Cawthorne-Nugent

MaaS is within the smart transportation sector of a smart city and intersects transport, ICT and energy. The Netherlands is hoping to contribute to the Smart City trend by implementing 7 MaaS Pilots throughout the country. The aim of these pilots is to optimise mobility through the use of MaaS (Rijksoverheid, 2019).

Currently there is a lot of literature on MaaS, however there is not a true definition of MaaS. The Ministry of Infrastructure and Water in the Netherlands have created a clear overview of what they believe MaaS is. As the integration of services seems central to the MaaS concept, this overview splits the integration stages into different levels. There are five levels starting with absolutely no integration at level 0 (see figure 1) (Harms et al., 2018).

Level 1 is where information integration takes place. This means that you can be informed about a multi modal journey, but you cannot book any tickets. The ticket booking would have to take place through each individual provider.

Level 2 does allow one to search, book and pay for a trip all in the same place.

Level 3 takes it one stage further and potentially supplies people with their daily mobility needs. This could be an alternative to owning a vehicle.

Level 4 brings societal goals in to the mix. It is no longer just about supply and demand, but it also serves to ameliorate green house gas emissions, for example (Harms et al., 2018).

It sounds like MaaS is too good to be true; successful implementation could lead to a reduction of emissions, congestion and increased travel convenience. However, what happens when MaaS does not work? These proposed MaaS pilots are partly funded by the government, thus also partly funded by the taxpayers.

Hence, which urban characteristics are necessary for the implementation of MaaS, so as to avoid taxpayers' money being wasted? Currently there is a research gap on this matter. The Dutch Knowledge institute of Mobility policy (KiM) have conducted a research on the ideal MaaS user, however the (urban) environment of users and MaaS is not mentioned (Zijlstra et al., 2019).

Furthermore, research has been done into successful MaaS schemes, such as; Helsinki, Vienna, Birmingham, Hamburg, Hannover, etc. The main focus within these papers are the legal frameworks within which the projects exist (Hirsschorn et al., 2019). Jittraprom et al. assesses multiple MaaS schemes, however they research the service

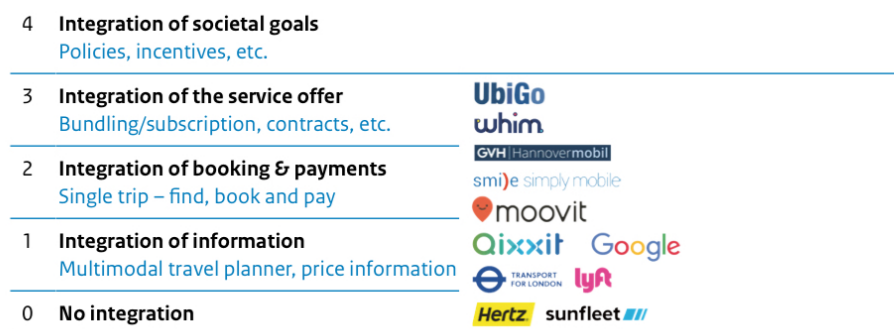


Fig. 2: Typology of MaaS with levels (left) and examples (right) (Sochor et al. 2017)

and platform side of MaaS in particular detail (2017).

So far, there is little negative literature. For instance, Assen tried to implement a scheme that would evolve into a MaaS scheme in phases. However, it did not get much further than the *platform layer* (see fig. 1). This is intriguing when reading the overwhelmingly positive MaaS literature. What would Assen have had to do or possess for MaaS to have been a success?

This thesis will research the characteristics that need to be present **before** the implementation of MaaS, to help ensure a successful implementation.

A successful implementation of MaaS could potentially hold extreme societal relevance. Theoretically MaaS should be able to offer transport and mobility to every subscriber. This means that parts of society that were previously forgotten in the transport sector, such as elderly and disabled people, could be catered for by MaaS (Utriainen & Pöllänen, 2018). If implemented correctly MaaS could significantly contribute to the quality of life for so many people.

However, that only works when the implementation runs smoothly and successfully. This research aims to provide tools to identify possible successful MaaS implementation locations.

Research Problem

In this research, the focus was directed from a post-MaaS understanding of characteristics to a pre-MaaS understanding of the necessary parameters needed. This required a literature review of successful MaaS cities of varying scales; Vienna, Birmingham and Hannover, these cities were then also compared to an unsuccessful MaaS city, Assen.

Interviews with governmental workers on both the regional and national level were conducted, as well as a further two interviews with experts. These interviews were to gain insight into the process of implementing MaaS and the unfortunate case of Assen. Finally, an Assen inhabitant interview was conducted to get the perspective of a possible Assen-MaaS consumer.

This approach allowed for a comparison between; successful and unsuccessful cases, provider and consumer perspectives, as well as discovering the necessary parameters and drivers for MaaS schemes. More specifically, I concentrated on the following research questions:

- (1) What are the main parameters of successful MaaS cases?
- (2) What went wrong for MaaS in Assen?
- (3) What are the necessary parameters for the successful implementation in Assen?

Thesis structure

The theoretical and conceptual framework will be the foundation of this thesis (see fig. 3).

The methodology will provide an overview of the steps taken when collecting the data and the reasons behind it.

The literature review will navigate the parameters and provide (most) of the theoretical characteristics needed for MaaS.

Then the case study of Assen will be introduced and explained. The analysis and interpretation of the interview data, along with the findings from the literature review will be provided under the *results* section.

Finally, the conclusion will contain the main findings, strengths and weaknesses of the research, recommendations and further areas of research.

Theoretical framework

Smart cities focus on the intersection between energy, transport and ICT (European Commission, 2012). The idea is that the integration of technology into urban life will create a higher quality of life (Geertman & de Klerk, 2016)., MaaS' primary focus is integrating transport with ICT, creating an easier, more efficient transport experience (This by means of a digital platform where you can book and pay for a trip (level 2 MaaS)(Sochor et al., 2017). There are multiple layers of governance that work at getting a MaaS scheme of the ground. Currently, there is a national push to roll out 7 MaaS pilots (Rijksoverheid, 2019). However, it is often the provinces (regional) and municipalities (local) that do the most work. Furthermore, it is usually the regional transport providers that are the aggregators of the project (Jitraprom et al., 2017).

Jitraprom et al. listed various core characteristics of MaaS schemes. They mention the multiple actors involved is such a scheme; the consumers, the transport supplier and platform owner (2017). In the Netherlands, the transport supplier is often the aggregator, not the service provider also known as the platform owner. The service provider is a crucial one of the involved parties, because the service provider sets out the conditions. They decide how much the service subscription costs and how the digital platform takes shape (Hirsschorn et al., 2019).

How the digital platform is designed could dictate whether the digital divide is widened or not (Harms et al., 2018). Although Zijlstra et al. conclude that young adults that have just started their professional career are the most fruitful age group for MaaS (2019). Meaning that the digital divide might not pose such a threat to the business plan.

Additionally, the service provider also creates the strategy that will be used during

the final stages of implementation; meaning the number of modes that are included, the level of customisation the service will provide etc. (Hirsschorn et al., 2019; Jitraprom et al., 2017). The included modes dictate the extent of multimodality within a scheme. It is important to gauge how people feel about using different modes (within one trip).

Alonso-Gonzalez, et al., look into the existing multimodal mindset and the willingness to pay (2020). Multimodal mindset is the willingness to incorporate different transport modes into personal travel patterns. There is a distinction between being open to new, innovative modes and more traditional modes. Another two psychological aspects are relevant, namely the attitude towards public transport in general and the attitude towards owning a private car. In the Netherlands attitudes towards public transport are more negative than attitudes towards bicycles or cars (Durand et al., 2018). Symbolic and affective motives towards car ownership have been found to be more powerful than utilitarian ones (Steg, 2015). MaaS can potentially offer a good alternative to private car use, however if no one wants to give up their car it will never reach level 4 where societal goals are integrated.

A cultural difference in approach is highlighted between Vienna and Birmingham. Vienna started with seven modes being included in MaaS, later modes got removed that were not used as much. Birmingham however, built up the amount of modes included and grew over time. In the end both cities will end up having 5 modes included (bike sharing is currently being added in Birmingham's scheme (Jitraprom et al., 2017) These are psychological and cultural aspects need to be considered whenever MaaS is implemented. That is why it is mentioned here. However it will not be

touched upon again as the research is mainly Netherlands based.

Furthermore, Araghi et al. delve deeper into the Dutch approach by the ministry. First of all there is another scale added to the mix, as we are no longer talking about a smart city but a region. The seven regional pilots are all characterised by their densely populated urban areas, apparently (2020). Meaning that population density must be an important parameter.

The policy framework is such that the pilots can initially last from two to three years. The ministry and the regions will co-finance during the pilot stage, but no longer. Each area has a certain focus group. The Groningen/Drenthe pilot is aimed at ameliorating the accessibility of rural areas; there are certain user groups that will be

targeted, such as school students, elderly and disabled people. This pilot is of added importance as Assen has been integrated into this new project.

The aim is to start regionally and then move towards a national roll out (Araghi et al., 2020).

Figure three illustrates an overview of all the concept mentioned and their relation to one another.

I hypothesise that a successful implementation of MaaS for a city demands a high user density, therefore a large population. Furthermore, I believe that the presence of a multi modal public transport network will be necessary as people will already be used to using public transport.

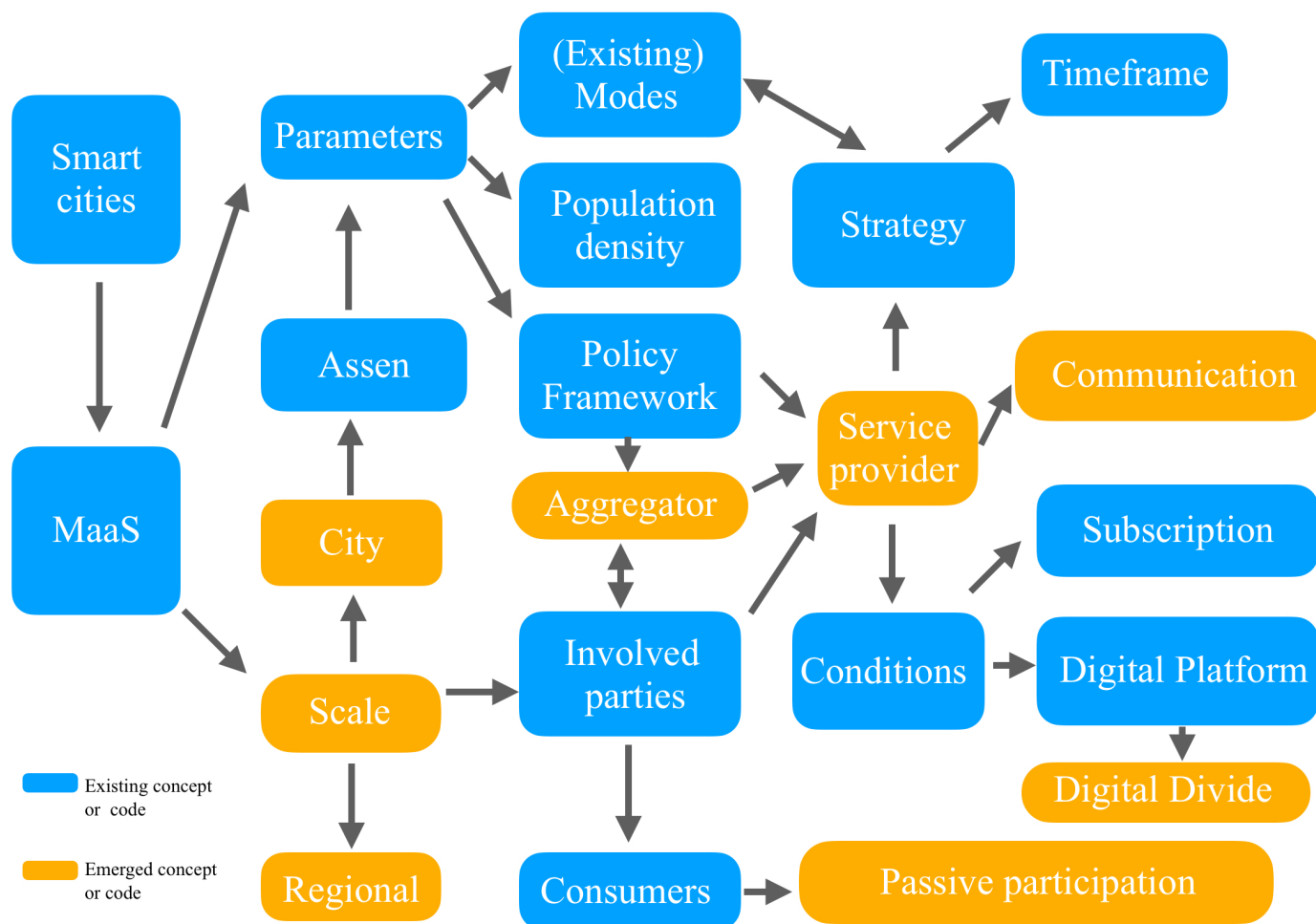


Fig. 3: Conceptual model

Methodology

Research Methods

To answer the research questions, a multi-method approach was employed, which consisted of: a literature review and multiple interviews with various stakeholders. This multi-method approach integrated mainly qualitative methods of inquiry to understand the relations of existing, concrete structures and the integration success of digital platforms within the narrative of smart mobility.

Literature review

The research was commenced by means of a literature review comparing three successful Western European MaaS cities of varying sizes. This was to identify possible crucial parameters that could be applied to anywhere.

This created a matrix in which Assen could be placed.

The conducted interviews was then used to add context to the Assen case. This context was delivered on a national, regional and local level to create a complete picture. Furthermore, the institutional perspective could be scrutinised, along with its values. The same applied to the individual's perspective of the local level. An interview guide was created for each sector of participants, so as to extract the most pertinent aspects from each sector. The different sectors interviewed are; governmental workers, experts and (Assen) inhabitant (See appendix 1, 2 & 3).

All the interviews will be semi-structured and some questions could therefore be added. The adding of questions could occur due to unexpected topics during the previous interviews, or spontaneously come up due to an answer from the interviewee present.

Coding

A code tree will be used for analysing the interviews (see fig 4) , Atlas Ti software will be used in analysing the interviews.

Three types of coding was used; descriptive, analytic and axial. The first round of coding was descriptive. Then these codes were analysed and linked with theory, creating the analytic code. During both rounds of coding the axial coding was used to maintain themes (see table 2 for an example). The main themes were definitions, drivers, scale and consumer perspective.

The coding was verified by an academic colleague familiar with the method and the results seemed similar.

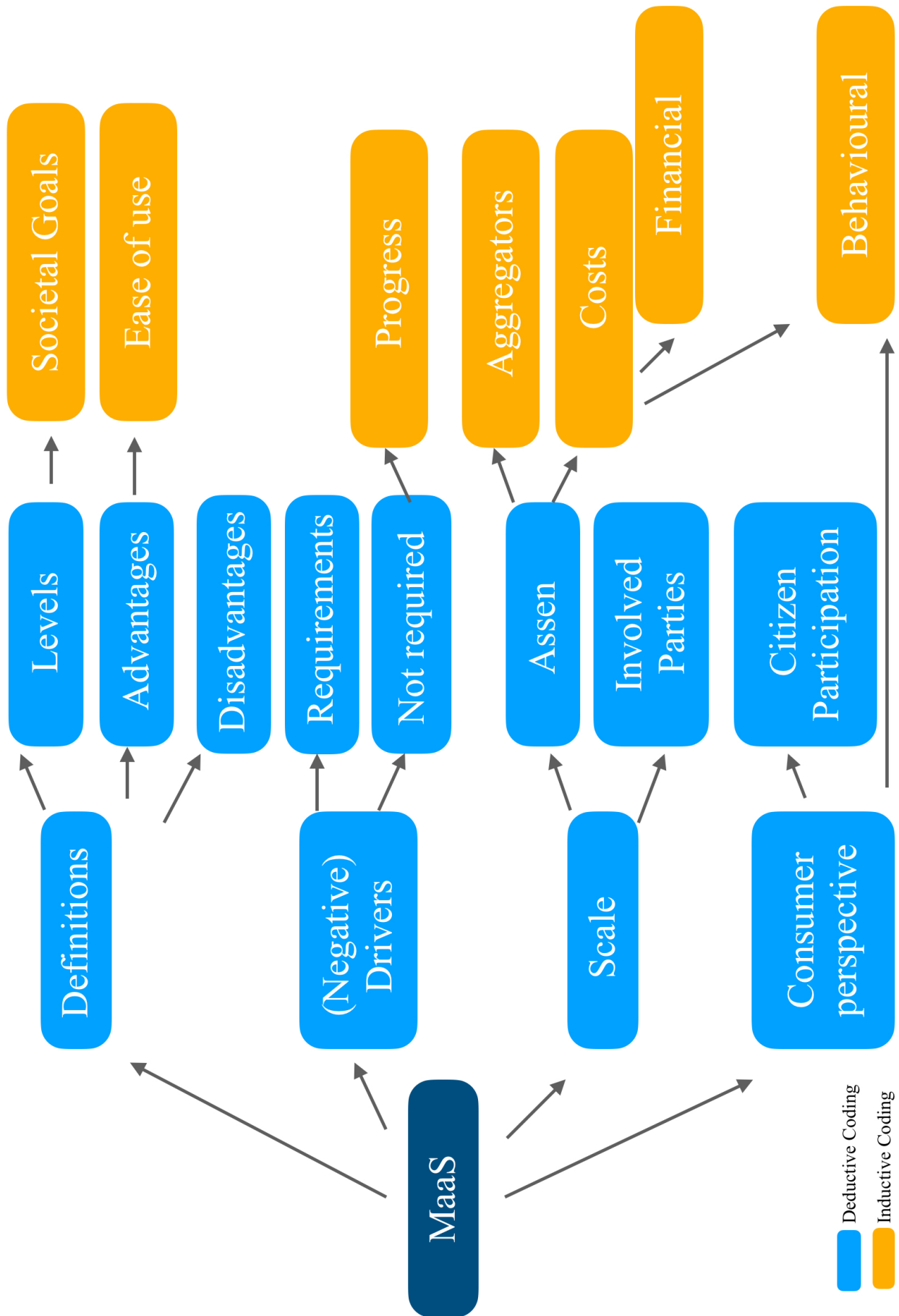


Fig. 4: Code tree for analysing the interview data.

Results

Literature review

In this next section MaaS cities will be discussed and compared finding parameters and characteristics needed for cities to implement MaaS successfully. Each example has had a MaaS scheme for over four years.

Hannover, Germany

Hannover, Germany, has had an operational MaaS scheme (Hannovermobil 2.0) in place since 2014. It contains 4 services; public transport, car sharing, taxi and regional trains (Jittraprom et al., 2018). This scheme does not operate under a fixed monthly payment which includes everything. The subscription gives you access to all the services at a discounted rate and at the end of the month you receive a bill for your usage (Kamargianni et al., 2016). The services were already present, however they were just brought together via the Hannovermobil app platform (Jittraprom et al., 2018). Furthermore, the Hannovermobil scheme exists alongside the traditional ticket buying options.

There are over half a million inhabitants in Hannover, with a population density of 2600 per km². The total area of Hannover is 204 km² (SBD, 2019). In 2016, the public transport network counted 216.2 million passengers (Region Hannover, 2017).

Birmingham, UK

Birmingham, UK, has almost twice the population at over 1.1 million inhabitants within a similar area; 267 km² (Birmingham City Council, 2019; WPR, 2020). This creates a population density of 4275 inhabitants per km².

The public transport authorities used the Swift card as an important integration element for offering multi operator, multi modal season tickets that also offers a pay-as-

you-go scheme. The swift card, like Hannovermobil, also co-exists with the previous ticketing systems. The project also aims to ameliorate issues as congestion and emissions (Hirschhorn et al., 2019).

It gives you access to the use of public transport, trains (in the West Midlands), taxi (within a 3 mile radius) and car use, with a view to expand the service to include bike share (Pangbourne et al., 2020). Due to the different operators it is difficult to gauge how many public transport users there annually, however, in 2015 there were 276.1 million bus passengers (Centro, 2015).

Vienna, Austria

In 2014, Vienna started with the Smile project. This project provided access to the following services; public transport, bike sharing, car sharing, taxi, parking garages, charging stations, regional trains and ferries. Then in 2015 it decreased the service package to just public transport, bike sharing, car sharing, taxi and parking garages, with which it has remained since (Kamargianni et al., 2016; Jittraprom et al., 2018). The public transport network length is 952.7 kilometres and counted 966.2 million passengers in 2018 (City of Vienna (b), 2019).

It does share its payment structure with Birmingham as it is on a pay-as-you-go scheme. However, like Hannovermobil, it is provided via a smartphone application (Jittraprom et al., 2018). The smile project connects software companies, engineers and environmental protection groups as this scheme is aiming for the highest level of MaaS integration (Kamargianni et al., 2016). This is all the more ambitious knowing that Vienna boast a population size of nearly 1.9 million (City of Vienna, 2019). Bringing a population density of 4600 inhabitants per km².

One thing that all three successful MaaS cities have in common is that the scheme aggregators were the public transport authorities (Kamargianni et al., 2016; Jittraprom et al., 2018; Pangbourne et al., 2020).

Case study: Assen.

So how does Assen compare to these cities? Well, in relation to the three previously mentioned agglomerations Assen is rather small at just 83.45 km², and just over 67 thousand inhabitants. This results in a population density of 819 inhabitants per km² (Gemeente Assen, n.d.). This low population density of Assen, thus likely the low consumer density could be an important factor.

Assen does have a bus, train and bike share service, which suggests that there is a footing for a MaaS scheme (9292, n.d.).

MaaS in Assen?

The original Assen Sensor City project was completed in 2014. One of the aims of this integrated sensor technology was that it could be used to aide the implementation of Multimodal travel assistance (Burgmeijer et al., 2016). A digital platform was created to gain insight into the real-time traffic situation when necessary (Burgmeijer, 2014).

However, as stated early and illustrated in figure 2, MaaS only starts at level 2 of integration. Sensor city would still fall within level 1. Meaning that inhabitants would be able to access all the information about the traffic situation, but not be able to book or pay for their trip. Unfortunately, this passed the inhabitants by (see appendix 4, table 4-9).

Furthermore, It would seem that there is not a perceived congestion issue for the inhabitants (see appendix 4, table 4-9),

Additionally, many inhabitants tend to use a bicycle to traverse the *last-mile*. Therefore, inhabitants might not think to use a traffic app as they will mostly be using cycle paths.

The future of MaaS in Assen

Assen will be included in the ongoing Groningen/Drenthe MaaS Pilot (Araghi et al., 2020). This means that Assen will in fact, be an interchange location in the MaaS system instead of a system in itself.

Furthermore, with the Pilot ranging over a larger area it could mean that the population density issue is resolved, as there will be more inhabitants over this large area. Drenthe is 2680 km², Groningen is 2960 km² (Metatopos, 2020; Provincie Groningen, 2008). This adds up to a total area of 5640 km². The sum population of both provinces (Groningen: 586 061 and Drenthe: 493 657) amounts to 1.1 million inhabitants. The population density for this area is 191.4 inhabitants per km². This still does not come close to the smallest population density of the succesful MaaS schemes. Although it is worth considering that these population densities were all for city wide projects, not for regional ones. In a small country like the Netherlands larger scale MaaS projects might be the only viable option.

Table 1. Summary of MaaS city characteristics.

City	Population size (Million)	Population density (Inhabitants/km ²)	Number of services provided	Public transport (PT)	Car sharing	Bike sharing	Taxi	Regional trains	Parking garage	Payment method	Platform	MaaS scheme aggregator	Annual PT passengers (million)
Hannover	0.532	2600	4	X	X		X	X		Monthly subscription	App	Public transport authorities	216.2
Birmingham	1.141	4275	4	X	X		X	X		Pay-as-you-go	Travel card	Public transport authorities	276.1 (ONLY BUS)
Vienna	1.897	4600	6	X	X	X	X	X	X	Pay-as-you-go	App	Public transport authorities	966.2
Assen*	0.067	819	3	X		X		X		-	-	Assen municipality	-
Groningen/Drenthe Pilot region*	1.079	1914		X	X	X	X	X		-	-	OV-Bureau Groningen/Drenthe	-

* Modes are selected using currently provided modes.

Interview data Analysis

In total five people were interviewed. The interview template used was semi structured (see appendix 1,2 and 3). All the interviews were conducted in English, except the G2 interview. Table 1 shows an overview of the respondents. Relevant information.

When analysing the data the word occurrence was also analysed, so as to gauge the most important aspects of this topic (see appendix 10). Figure 5 shows a brief overview of almost all the words used. There were no unexpected factors that came to light following the word occurrence analysis.

The top five used words were;

1. MaaS
2. Transport
3. People
4. Use
5. Assen

Transport and People were mentioned almost the same amount of time; transport 60 times and people 59 times. This suggests that both the transport modes and the people using these modes would be considered almost equally when creating a MaaS scheme.

Table 2: Overview of the interview respondents

Interviewee	Nationality	Gender	Position	Level
G1	Dutch	Male	Governmental worker	National
G2	Dutch	Male	Provincial governmental worker	Regional
E1	Dutch	Male	Mobility expert	International
E2	Dutch	Female	Mobility expert	International
I1	Dutch	Female	Assen inhabitant	Local

MaaS definitions and understanding

As already stated in the literature review, there is a lot of disparity between MaaS definitions and this was no different among the respondents. However, one element that both the mobility experts and government workers mentioned was that it was a digital platform that integrated all the travel modes, giving the consumer an easy, multi-modal option (see Appendix 4, table 4-1). The definitions of the experts and the governmental workers were inline with the minimally required level 2 as stated by the Dutch government (Sochor et al., 2017).

However, when asking a member of the general population, this person had no idea what MaaS was and did not understand why it was necessary. Furthermore, both government workers commented that getting the general public to grasp the MaaS concept could be difficult.

Parameters

There are certain things that a MaaS scheme has to have; integration of pricing up, paying and booking a journey, all on one platform is the minimum. However, when it comes to characteristics that make cities suitable to host a MaaS scheme, there is less certainty. There were suggestions of factors that might aid the smooth implementation of a MaaS scheme, but few of them were set in stone. The two factors that are important are the presence of multiple transport modes before the implementation of MaaS and secondly, the population density. Network density was not considered a necessary parameter (see figure 6). Mainly because there are also success stories of cities with a

very low network density such as Helsinki (Hirsschorn et al., 2019). The importance of the infrastructure in place came down to the multi modality of the network.

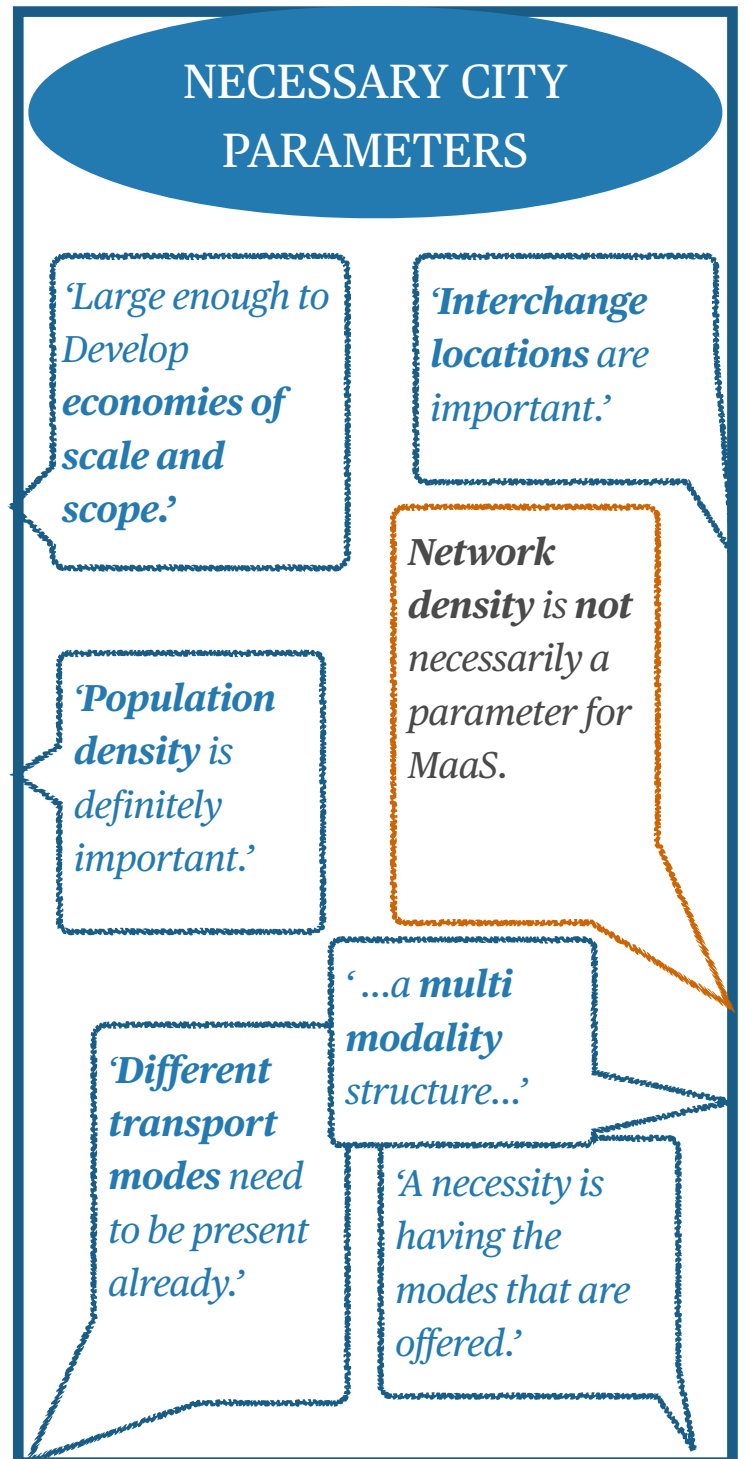


Fig. 6 : Necessary MaaS city characteristics.

Scale

MaaS could possibly work well in the Randstad as there is already a good and well used public transport network in place (see table 3). However, the Randstad is a densely populated area of the Netherlands as it contains the 4 most densely populated cities; Amsterdam, Rotterdam, The Hague and Utrecht (CBS, 2019). Unfortunately the Northern regions of the Netherlands do not contain such high population densities. Due to the low population density it is unlikely to be feasible in these, more rural, regions according to G1. However, Araghi et al. described the pilot areas, including the Groningen/Drenthe pilot, as densely populated areas (2020). Furthermore, the pilot in question is aimed at school children, elderly and disabled to improve the accessibility of the rural areas for these user groups. G1 did not believe that disabled people or elderly would be MaaS users.

According to G1 disabled users would not use it due to their current transport habits. Changing their transport behaviour would come at too higher (behavioural) cost. People will simply not alter their transport behaviour if the costs are deemed too high (Rli, 2014).

Additionally G1 did not believe elderly people would use it because of the digital divide created by the MaaS platform being a digital application on a smartphone. This would suggest that the MaaS pilot could potentially be unsuccessful in its designated area. The mobility experts on the other hand felt that MaaS held great potential for rural, inaccessible areas. Furthermore, they believed it could provide a lot more mobility independence for elderly and disabled users to an extent. They were however, slightly concerned by the digital divide for the elderly users. G2 agreed that the digital platform could form a barrier, but also agreed that MaaS had to be accessible for various disabilities.

Table 3: Coding G1 interview, Scale; regional vs. City MaaS schemes.

Text	Descriptive code	Analytic code	Axial code
Q: Do you think that regional MaaS schemes could be more successful in the Netherlands than city schemes?			
G1: Yes, they could be. I think MaaS could work in the Randstad, that's possible. There is already a good public transport network and people are used to using it as well. But I don't think it would work in rural regions because they just don't have the [user] density required for a scheme like MaaS. The [user] density is really important for MaaS. I just don't think it would be feasible for these areas. Maybe you could have a voluntary MaaS with bicycle sharing etc. But that then would not be an official MaaS scheme.	Existing modes - public transport Rural regions Population/user density	MaaS implementation works better if there is an existing infrastructure of modes. Rural regions cannot sustain MaaS projects due to low consumer density.	Infrastructure - existing infrastructure Rural - subpar amount of consumers

Involved Parties

There are three levels of governance in the Netherlands; national, regional and local. When it comes to MaaS projects regional and local level often work together along with the public transport authority for the region (Araghi et al., 2020; Appendix 4, table 4-4). Once the general outlines have been established the the project goes to tender. There are currently 24 companies eligible to be chosen (Araghi et al., 2020; Hirsschorn et al., 2019). This will then be the service provider that will be in charge of getting the project to the market. They decide the strategy, so the timeframe and the amount of modes that will be integrated into the scheme (see Appendix 4, table 4-4; table 4-7).

Furthermore, this company also decides the conditions. There are a few conditions for the users to consider such as, the costs. There will be both behavioural costs and a financial costs to switching to a MaaS app or platform. The behavioural costs will come in the forms of having to break habits and think about your travel again (Rli, 2014; Appendix 4, table 4-10).

Financial costs come as subscriptions to the Mobility Service (see appendix 4, table 4-1). Both the experts and the governmental officials stated that the cost of a subscription needs to be set carefully as it could increase the poverty divide if too expensive, it has to remain accessible. Furthermore, if it is too expensive it will deter people from using it (Harms et al., 2018). It should be within a sensible amount, not nearly €400,- a month like in Helsinki, as G1 mentioned (. None of this has yet been decided for the project that will cover Assen as the serviceprovider has not yet been selected according to G2. Only once the service provider has been chosen,

can the communication, conditions and the strategy of the scheme take shape (see figure 3; appendix 4, table 4-4).

(Passive) participation

Consumers contribute passively, through consumer platforms or representatives of certain market groups (see appendix 4, table 4-5). Ultimately the amount of citizen participation and consumer contribution is down to the third party, the service provider.

The mobility experts and the governmental workers all believe that theoretically it makes sense to get citizens involved so that the MaaS project is tailor-made to their wants and desires (see appendix 4, table 4-5). However, this could also be very impractical. It would take too long to make sure that everyone present had the correct understanding of what MaaS is. Currently there is a lot of disparity in the levels of comprehension of MaaS, according to G1. The suggestions made by citizens might also not be financially viable. Consulting people and then not implementing any of their suggestions might lead to bad feeling. It would just be a form of tokenism (Arnstein, 1969). Furthermore, G2 does not believe that citizens have to understand everything that the government does (see appendix 4, table 4-5). Additionally, the Assen inhabitant when asked whether they would have liked to have been more involved said:

'Hmm yeah. I really don't know. I have never considered this being a possibility...whether I would like to be involved in some kind of community that is using these sensor city type things, I don't know because I am not really into such things.'

This is not the most enthusiastic response to an opportunity for participating. This begs the question as to whether citizen participation would be more for show rather than an active tool. It would be using tokenism participation or make the decision-making parties feel better. As long as the transport demand is met by the project, the citizens might not have to be actively involved. As G2 mentioned earlier, the passive methods can also be very informative.

Demand or Supply driven

E1 believes that MaaS is utterly supply driven as technology dictates what is feasible. As technology is evolving all the time, so is MaaS. However, this would mean that consumers and citizens would not be able to participate in the development process. Currently citizens are not actively involved in setting up MaaS schemes.

However, both governmental officials say that MaaS is demand driven as there is always a desire for faster, easier transport. According to G2 there is often a balance between demand, supply and politically driven motives for a concept like MaaS. It can trickle down from the national level to the provincial level and onto the municipal level, mainly because of the societal benefits it could

potentially possess. This is inline with what Araghi et al. concluded in their research too.

Contradictory to this, both government officials also suggest that MaaS is partially supply driven. G1 says that if a person has more options it is good for them (see appendix 4, table 4-6). This would lean towards a Vienna approach of integrating as many modes as possible to give people the maximum amount of choice. G2 mentions that it cannot be fully demand driven as no one has asked for a problem to be solved (see appendix 4, table 4-6). It is a solution to a non-existing problem in some cases.

This is where E2 believes that Assen went wrong, as there was no problem to be solved in Assen. The Assen inhabitant also agreed that a mobility platform was not necessary in Assen as it was too small to warrant it. There are no congestion issues and almost everyone uses their bike if it is too far to walk (see appendix 4, table 4-9).

Strategy

First of all, there is a large research gap of the implementation strategies of MaaS schemes within the existing literature. Therefore it was difficult to corroborate statements from the interview participants.

G2 said that the Netherlands purposely chose to use Public Private Partnerships (PPP) when it came to MaaS. The idea behind this was that the government (public) would keep societal aspects in sight, whereas the private side would focus on the financial viability of the project (see appendix 4, table 4-4, table 4-7 & table 4-8). Furthermore, using PPPs helps ensure a level playing field when choosing the third party that will set the strategy and conditions. The strategy has not yet been set for the Groningen/Drenthe

F. Cawthorne-Nugent

pilot, as the third party has not yet been chosen (see appendix 4). The third party is allowed to use structures, such as bus stops, that are owned by the government for marketing and advertising. Otherwise known as the communication of the project to the outside world.

E2 believes that one of the main issues with the Assen project is that so few people knew about the project and the aim of it. Both E2 and the Assen inhabitant did not know what the municipality wished to achieve with the project in the long run. Furthermore, peop

Communication is also down to the private party, which in the case of MaaS is the service provider (see appendix 4, table 4-4).

The communication when it came to Assen's Sensor city was that non-existent that when G2, was asked about the relation between sensor city and MaaS, they said they had never made the connection between the two. However, one of the main 'selling points' of Sensor city was that it laid the foundation for an integrated mobility application. There was even an Assen app that was created (Burgmeijer, 2014).

Conditions

The two main conditions when it comes to MaaS are the digital platform and the subscription (Jittraprom et al., 2017).

First of all, the digital platform. As discussed earlier the digital platform caused for some concern among the experts and governmental workers. They believed it could exclude the elderly travellers from using MaaS (see appendix 4). The platform should be developed in such a way that everyone can use it (see appendix 4, table 4-8). There are alternatives to having just an app, some MaaS schemes also use a website, meaning that a user would not be obliged to own a smartphone (Jittraprom et al., 2017). In the Netherlands, the MaaS app is often linked to a card. Thus, technically the app coordinates your trip (travel information and bookings) and the card keeps track of the costs (Araghi et al., 2020; Appendix 4, table 4-1).

The subscription costs are set by the service provider (see figure 3; appendix 4, table 4-8). As G2 stated, these have to be quite high, because a company does have to make a profit. G1 mentioned that a subscription does not have to be a monthly responsibility. Subscriptions can also be daily (see appendix 4, table 4-8). Furthermore, the subscription costs should be reasonable. To return to a previous example, €400,- a month is too much (see appendix 4, table 4-10).

Conclusion

This thesis studied the necessary parameters for implementing a MaaS scheme in Assen. The topic was relevant due to the Dutch governments recent push to roll out multiple MaaS schemes across the country. Assen was chosen as a case study because previous attempts at technology integration in everyday life had failed. This qualitative research was conducted by means of a literature review on successful MaaS schemes which formed the basis of the parameter identification. Unfortunately there is not a lot of literature outlining and/or comparing physical attributes of MaaS cities, both pre and post MaaS implementation. This caused for a limited number of parameters. However, this does illustrate the need for more research on this topic.

The semi-structured interviews with government officials, mobility experts and an Assen inhabitant gave additional insight into the specific case. This research was conducted during the COVID-19 outbreak, which made arranging interviews challenging. Furthermore, I had organised interviews with parties that seemed relevant at the start of the research. Once the interviews had been conducted it was no longer possible to arrange an interview with one of the 24 companies eligible to be service providers.

Nevertheless, it is clear that user density and existing modes are important parameters

for implementing MaaS schemes. Furthermore, for the Groningen/Drenthe Pilot the digital platform will be an important factor as one of the main target groups is elderly and disabled. This is unique to the other 6 pilots planned in the country. Therefore, it would be advisable to do extensive, place-specific market research, including consumer participation. For a business case focussing on elderly and disabled users to be financially viable in a region with exceptionally low population density (and therefore user density), the supply will have to match demand perfectly. Furthermore, as this pilot differs from the others in both positioning and target audience, (market) research done for a different pilot is unlikely to be applicable to the Groningen/Drenthe one.

This research has identified an extensive research gap in the field of physical MaaS city attributes, as well as illuminating the existing debate as to whether MaaS is supply or demand driven. Not to mention the fact that none of the government officials or mobility experts knew how the demand was measured. This area needs to be explored further in the future.

Additionally, the outbreak of COVID-19 could lead to a change in mobility behaviour. A relevant line of research would be whether people were more likely to use it if it informed them of the quietest route, for example.

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F. Cawthorne-Nugent

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Appendices

1. Interview guide (G1 & G2)

Table 1: Interview guide for governmental official.

Interview Stage	Purpose	Comments	Questions
Opening			
Greetings	During the opening the participant will be informed on how the data will be treated. Furthermore, it is used to ascertain whether the participants wish to remain anonymous.	This conversation will be recorded. The recording will be saved on a password protected device. Once the recording has been transcribed, it will be deleted. You may of course, withdraw your participation at any point.	Are you comfortable with this arrangement? Would you like to remain anonymous?
Introduction			
Getting acquainted	Here I will introduce myself and the participant will introduce themselves. Then the topic will be introduced by means of light opening questions.	This research looks into the implementation of MaaS and when combining technology with transport works and when it does not. The focus will be on the city of Assen as the unsuccessful case. The aim is to discover necessary parameters for the implementation of MaaS.	Do you have any questions before we start? Could you please introduce yourself?
Main body			
Warm-up questions	This is just to ease the participant into the subject.	Throughout the interview there will be room to wander off topic a little.. Do not worry if you do not know the answer to a question either.	What is your definition of MaaS? What are the main advantages and disadvantages?

Interview Stage	Purpose	Comments	Questions
Main questions	This should provide the main (new found) insight into the subject. A focus will be placed upon Assen.		<p>Why did the municipality of Assen want to implement MaaS? What was the main trigger for implementing it?</p> <p>What characteristics made Assen suitable for implementing MaaS? Was the existing transport network considered suitable? Was there a call for it from the citizens (external trigger)?</p> <p>How was the scheme communicated to the inhabitants/users? Were the inhabitants informed before hand? Were the inhabitants involved in the implementation? How were the inhabitants informed? In what manner?</p> <p>Why was MaaS discontinued in Assen? What were the main triggers for stopping the scheme? Why do you think it did not work in Assen? Do you envisage that the scheme will be revisited at any point? What would have to change for the scheme to be revisited?</p>
Closing questions	This is a good source of new information that would potentially be missed otherwise.		<p>Is there anything else you want to add to the discussion?</p> <p>Do you think I've forgotten to ask something important?</p>

Interview Stage	Purpose	Comments	Questions
Closing			
Clarity and gratitude	This section is used to clarify what will happen next and thank them for their participation.	Thank you ever so much for taking part in this interview. I will transcribe the recording and then send you a copy to approve via email. Once you have approved it, the recording will be deleted. If you wish to withdraw your participation at any point you can do so, just inform me by sending me an email.	Do you have any questions?
Farewells	To say goodbye	Thank you once again for all your time and input. I hope you have a lovely day. Bye!	

2. Interview Guide (E1 & E2)

Table 2: Interview guide for mobility expert

Interview Stage	Purpose	Comments	Questions
Opening			
Greetings	During the opening the participant will be informed on how the data will be treated. Furthermore, it is used to ascertain whether the participants wish to remain anonymous.	This conversation will be recorded. The recording will be saved on a password protected device. Once the recording has been transcribed, it will be deleted. You may of course, withdraw your participation at any point.	Are you comfortable with this arrangement? Would you like to remain anonymous?
Introduction			
Getting acquainted	Here I will introduce myself and the participant will introduce themselves. Then the topic will be introduced by means of light opening questions.	This research looks into the implementation of MaaS and when combining technology with transport works and when it does not. The focus will be on the city of Assen as the unsuccessful case. The aim is to discover necessary parameters for the implementation of MaaS.	Do you have any questions before we start? Could you please introduce yourself?
Main body			
Warm-up questions	This is just to ease the participant into the subject.	Throughout the interview there will be room to wander off topic a little,. Do not worry if you do not know the answer to a question either.	What is your definition of MaaS? What are the main advantages and disadvantages?

Interview Stage	Purpose	Comments	Questions
Main questions	This should provide the main (new found) insight into the subject.		<p>Why would a municipality want to implement MaaS? What are the main triggers for wanting to implement it?</p> <p>What characteristics a city suitable for implementing MaaS? When is the transport network considered suitable? What should the network density ideally be? What should the population density/ user density be? Is there a required level of internet connection needed throughout the city? Who is normally responsible for this connection, if needed?</p> <p>How are such schemes communicated to the inhabitants/users? Are the inhabitants informed before hand? Are the inhabitants involved in the implementation? Does the success rate highly depend on a certain communication method?</p> <p>Why do you think MaaS was discontinued in Assen? Do you envisage that the scheme will be revisited at any point? What would have to change for the scheme to be revisited?</p>

F. Cawthorne-Nugent

Interview Stage	Purpose	Comments	Questions
Closing questions	This is a good source of new information that would potentially be missed otherwise.		<p>Is there anything else you want to add to the discussion?</p> <p>Do you think I've forgotten to ask something important?</p>
Closing			
Clarity and gratitude	This section is used to clarify what will happen next and thank them for their participation.	<p>Thank you ever so much for taking part in this interview. I will transcribe the recording and then send you a copy to approve via email. Once you have approved it, the recording will be deleted.</p> <p>If you wish to withdraw your participation at any point you can do so, just inform me by sending me an email.</p>	Do you have any questions?
Farewells	To say goodbye	Thank you once again for all your time and input. I hope you have a lovely day. Bye!	

3. Interview Guide I

Table 3: Interview guide for Assen inhabitant

Interview Stage	Purpose	Comments	Questions
Opening			
Greetings	During the opening the participant will be informed on how the data will be treated. Furthermore, it is used to ascertain whether the participants wish to remain anonymous.	This conversation will be recorded. The recording will be saved on a password protected device. Once the recording has been transcribed, it will be deleted. You may of course, withdraw your participation at any point.	Are you comfortable with this arrangement? Would you like to remain anonymous?
Introduction			
Getting acquainted	Here I will introduce myself and the participant will introduce themselves. Then the topic will be introduced by means of light opening questions.	This research looks into the implementation of MaaS and when combining technology with transport works and when it does not. The focus will be on the city of Assen as the unsuccessful case. The aim is to discover necessary parameters for the implementation of MaaS.	Do you have any questions before we start? Could you please introduce yourself?
Main body			
Warm-up questions	This is just to ease the participant into the subject.	Throughout the interview there will be room to wander off topic a little. Do not worry if you do not know the answer to a question either.	Do you know what 'Mobility as a Service' is? Have you ever heard of it? Do you know of an example of where it has been implemented? Did you know that the municipality of Assen tried to implement it in the past?

Interview Stage	Purpose	Comments	Questions
Main questions	This should provide the main (new found) insight into the subject.		<p>Why did the municipality of Assen want to implement MaaS? Do you think that Assen needs Mobility as a Service? Why do you think the municipality wanted to implement it?</p> <p>What characteristics made Assen suitable for implementing MaaS? Are the roads in Assen busy (at peak times)? Is there a lot of congestion in general? Is it difficult to travel (the last mile) within Assen? Are you dissatisfied with the current transport system?</p> <p>How was the scheme communicated to the inhabitants/users? Were you informed before hand? How were you informed? In what manner? Were you offered the chance to be involved in the implementation?</p> <p>Why do you think the MaaS was discontinued in Assen? Why do you think it did not work in Assen? Do you envisage that the scheme will be revisited at any point? Would you like it to be revisited at any point?</p>

Interview Stage	Purpose	Comments	Questions
Closing questions	This is a good source of new information that would potentially be missed otherwise.		<p>Is there anything else you want to add to the discussion?</p> <p>Do you think I've forgotten to ask something important?</p>
Closing			
Clarity and gratitude	This section is used to clarify what will happen next and thank them for their participation.	<p>Thank you ever so much for taking part in this interview. I will transcribe the recording and then send you a copy to approve via email. Once you have approved it, the recording will be deleted.</p> <p>If you wish to withdraw your participation at any point you can do so, just inform me by sending me an email.</p>	Do you have any questions?
Farewells	To say goodbye	Thank you once again for all your time and input. I hope you have a lovely day. Bye!	

4. Interview overview per topic

Table 4-1: Interview overview of MaaS topic

Topic	Person	Code	Quotes
MaaS	G1	1) Maas definition, Advantages	1) Transport demand oriented, You should be able to use different kinds of modes in such a way that with one subscription and one ticket works for everything. Also preferably you are assisted by a sort of digital app or digital program...Maybe a monthly subscription or maybe a daily.
		2) Maas definition, Maas levels	2) Level 1, is only traffic information. Level 2 is that you also integrate it with a sort of planning tool and a subscription. The highest level is that you are also connected to all kinds of societal goals.
	G2	MaaS definition	Mobility as a Service is een manier waarop er een multimodaal platform wordt ingericht, nou via een app maar het kan ook anders, waarmee mensen vraag gericht, dus op basis van persoonlijke voorkeuren, een keten reis kunnen maken. En het maken gaat om het reizen, boeken, plannen en het betalen. En officieel hoort daar ook nog bij het ondersteunen tijdens het reis en het aanpassen op het moment dat je een reis geboekt heb.
	E1	MaaS definition	My definition would be a digital platform for integrated transport service.
	E2	MaaS definition, Advantages	A platform that brings together transportation demand and transportation supply. And it is related to multi modality...it makes things easy. It's easier to get the information about travelling, it's easier to pay. It brings together demand and supply.

Table 4-2: Interview overview of Parameters topic.

Topic	Person	Code	Quotes
Parameters	G1	1) Requirements, scale	But I don't think it would work in rural regions because they just don't have the [user] density required for a scheme like MaaS.
		2) Requirements	I would say that Interchange locations are important.
	G2	1) Requirements, ease of use, Assen project.	1) Aan de ene kant moet de dienst, al het vervoer aan bod in Groningen en Drenthe ontsluiten, dus in de dienst opnemen. Alle functionaliteit, tegelijkertijd vinden wij, dat alle reizigers er bruikbare van moeten kunnen maken.
		2) Requirements.	2) Een vereiste is bijvoorbeeld alles wat er aangeboden wordt [infrastructure wise] en dat is voor een groot deel ook nog publiek gefinancierd...Maar als je het puur over het fysieke hebt, eigenlijk dus alles wat publiek of mede publiek gefinancierd is.
	E1	1) Requirements	1) ... you need a sort of minimum inhabitants, so you need to be able to produce or develop economies of scale and scope.
		2) Requirements, negative drivers	2) ...MaaS projects do not fail as a consequence of lack or incompatible technology but as a result of institutional barriers.
	E2	1) Requirements	1) I think there should be a situation where you could have a multi modality structure.
		2) Requirements, Assen project	2) There should be a problem to need a solution!
	I	Requirements	The total agglomeration, has to have more than five hundred thousand to one million inhabitants.

Table 4-3: Interview overview of Scale topic

Topic	Person	Code	Quotes
Scale	G1	1) Scale	Q: regional MaaS schemes could be more successful in the Netherlands than city schemes? 1) G1: Yes, they could be.
		2) Scale, requirements	2) But I don't think it would work in rural regions because they just don't have the [user] density required for a scheme like MaaS.
	G2	1) Scale, aggregators, involved parties	1) Ik denk dat het misschien meer vanuit de provincie ontstaat. We zijn ook een laag boven de verschillende gemeenten maar uiteindelijk heb je daar een collectief belang in en probeer je daar samen in te verenigen. Ik denk dat dit, specifiek voor MaaS, dat is aan de andere kant ook begonnen vanuit de ministerie die veel tijd en energie inzetten, die eigenlijk een traject aan het inrichten was.
		2) Scale, aggregators, financial aspects	2) ...op het moment dat je winst maakt en je kijkt naar bijvoorbeeld ons regio dan ligt het niet zo zeer voor de hand om in het landelijk gebied een hele grote dienst uit te rollen.
		3) Scale, societal goals, financial aspects	3) Tegelijkertijd kan kan die diensten ook wel veel makkelijker maken en misschien ook wel goedkoper als je op grotere schalen afspraken kan maken.
	E1	1) Scale	1) Economies of scale [are necessary]
		2) Scale	2) But they are still working on it. They have this, it's also called MaaS-pilot now, but it's for the entire region, the entire Groningen-Assen
	I	Scale, Assen project.	Q: Would MaaS be more successful on a regional scale? Instead of just a city scale for somewhere like Assen? So that you include the rural areas. I: I don't think so.

Table 4-4: Interview overview of Involved parties

Topic	Person	Code	Quotes
Involved parties	G1	Involved parties, Citizen participation	<p>Q: <i>At what stage do inhabitants get informed about the implementation of a Maas scheme?</i></p> <p>G1: It depends on the company that is running it.</p>
	G2	1) Involved parties, aggregator, financial aspects	1) In beide gevallen komt er een partij bij, een commerciële partij, en die moet in logische wijze geld verdienen door middel van een pilot met de overheid proberen ze daarin te helpen, te laten opstarten en ontwikkelen.
		2) Involved parties, aggregators, scale	2) Ik denk dat het misschien meer vanuit de provincie ontstaat. We zijn ook een laag boven de verschillende gemeenten maar uiteindelijk heb je daar een collectief belang in en probeer je daar samen in te verenigen. Ik denk dat dit, specifiek voor MaaS, dat is aan de andere kant ook begonnen vanuit de ministerie die veel tijd en energie inzetten, die eigenlijk een traject aan het inrichten was,
		3) Involved parties	3) De grootste zoektocht is denk ik dat er ook een derde partij erbij komt.
		4) Involved parties, aggregators, drivers, societal goals	4) Nederland is bewust gekozen voor publiek/privaten samenwerking, dus het samen met de markt ontwikkelen waarbij behorens de overheid vooral dus de sociale aspecten onder de aandacht brengen, maar vooral ook zorgen dat er een gelijk speelveld ontstaat.
	E1	Involved parties, aggregators, scale	The pilots that I informed you about are also driven by the municipality or province, or regional entity.
	E2	Involved parties, aggregators	I can imagine if you look in this region [North of the Netherlands] that OV Bureau could initiate something like that.

Table 4-5: Interview overview of (Passive) Participation

Topic	Person	Code	Quotes
(Passive) participation	G1	1) Citizen participation	1) I think so, because it is always good to ask people what they want to do. If you can tailor the situation in such a way that it fits the preferences of the people then of course it's always better.
		2) Citizen participation	2) I think there could definitely be more done early on. However it is always difficult with MaaS as people often don't understand it or know a lot about it. So it's difficult to get opinions about something people don't understand.
	G2	1) Citizen participation, involved parties	1) De mensen zijn wel betrokken maar voor alsnog is dat nog indirect. Het is niet zo dat wij nu, zeg maar, op straat vragen 'Wat vind jij ervan?' Maar wel via bijvoorbeeld consumentenplatform, of via vertegenwoordiging van bepaalde doelgroepen proberen we daar wel de experts in te betrekken.
		2) Citizen participation, Involved parties, Assen project	Het is ook niet dat alles wat er gebeurt van de overheid wegen dat mensen dat bewust moeten weten.
	E2	Citizen participation	Yes it would be good to involve potential users, to think about what such a tool or such a platform should offer so that you really take into account the user perspective.
	I	Citizen participation, Assen project, awareness	Q: <i>Would you like to have been more informed beforehand and maybe been involved?</i> I: Hmm yeah. I really don't think so.

Table 4-6: Interview overview of Demand and Supply driven

Topic	Person	Code	Quotes
Demand or Supply driven	G1	1) Drivers, Citizen participation, demand	1) If there is a demand for certain transport modes then it makes sense to implement them.
		2) Drivers, supply	2) But it can always be better, of course, and always more integrated, that makes it always more interesting, because I think, basically if you have more options as a person then that is always good for you.
	G2	Drivers, supply	Maar er is in die markt niemand die gevraagd heeft om het op te lossen
	E1	1) Drivers,	1) No, it's driven by technology. It's driven by what is technologically feasible.
		2) Drivers, supply	2) So it's in that sense very much supply driven. I think based on the old IT idea that this project will be so novel and innovative that it will create its own demand.
	E2	Drivers, requirements, Assen project,	There should be a problem to need a solution!

Table 4-7: Interview overview of Strategy

Topic	Person	Code	Quotes
Strategy	G2	1) Societal goals, drivers, Involved parties	1) Nederland is bewust gekozen voor publiek/privaten samenwerking, dus het samen met de markt ontwikkelen waarbij behorens de overheid vooral dus de sociale aspecten onder de aandacht brengen, maar vooral ook zorgen dat er een gelijk speelveld ontstaat.
		2) Awareness, Involved parties	2) Dat is een derde partij, en die derde partij plan bij dat de mensen gebruik gaan maken van die dienst. Dus die zullen daar invulling aan moeten geven. Die zullen daar wellicht marketing campanges op gaan zetten en dat soort aspecten. Natuurlijk hebben wij vanuit de overheid ook verschillende kanalen om burgers te betrekken. Dat kan zijn fysiek bijvoorbeeld er rijden openbaar vervoer wat vanuit de overheid bekostigd wordt bijvoorbeeld busshaltes en knooppunten, dus we hebben fysieke plekken die je daarvoor zou kunnen benutten.

Table 4-8: Interview overview of Conditions

Topic	Person	Code	Quotes
Conditions	G1	1) Condition, requirements, disadvantages	1) And I think an important requirement is that you should not have to pay too much money for it, for a subscription.
		2) Condition, requirements, MaaS definition	2) A monthly subscription or maybe a daily, but at least that you can use the different modes without buying separate tickets etcetera.
		3) Condition, MaaS definition	3) Preferably you are assisted by a sort of digital app or digital program that fully helps you in planning your trips.
	G2	1) Condition, ease of use, requirements, Assen project.	1) Aan de ene kant moet de dienst, al het vervoer aan bod in Groningen en Drenthe ontsluiten, dus in de dienst opnemen. Alle functionaliteit, tegelijkertijd vinden wij, dat alle reizigers er bruikbare van moeten kunnen maken.
		2) Condition, financial aspects	2) Dus die [commerciele partij] moet op enig moment wel uit de kosten komen aangezien het een comercieele partij betreft en die moet ook ergens wel winst maken.

Table 4-9: Interview overview of Assen topic

Topic	Person	Code	Quotes
Assen	G1	Assen project, MaaS definition, requirements	Interchange locations are important
	G2	1) Assen project, requirements, ease of use, condition	1) Aan de ene kant moet de dienst, al het vervoer aan bod in Groningen en Drenthe ontsluiten, dus in de dienst opnemen. Alle functionaliteit, tegelijkertijd vinden wij, dat alle reizigers er bruikbare van moeten kunnen maken.
		2) Assen project, progress, aggregators, involved parties	2) We zitten nu in de voor beoogde van aanbesteding, om daadwerkelijk die dienst ook uit te gaan vragen [Groningen-Drenthe Pilot].
		3) Assen project	3) Ik vind dat sensor city ook primair eigenlijk helemaal niet gericht was op burgers. Ik denk dat dat wel een essentieel verschil is. Wie is de klant of de gebruiker van een MaaS dienst. Dat is in feite iedereen, in sensor city dat was – ik weet ook niet alle details van – maar met name een netwerk waarin allerhande partijen, hetzij vanwege onderzoek, hetzij vanwege dienstgoed ontwikkelen gebruik konden maken van dat netwerk voor de slimme toepassing.
	E1	Assen project, progress, Scale	But they are still working on it. They have this, it's also called MaaS-pilot now, but it's for the entire region, the entire Groningen-Assen region.
	E2	1) Assen project	1) I think there are around two hundred sensors in Assen and they mainly measure the traffic flow of cars.
		2) Assen project, negative driver, societal goals	2) Almost all infrastructure is renewed in Assen so there are no traffic congestion issues, so there is nothing to solve.
		3) Assen project, drivers, negative drivers, requirements	3) There should be a problem to need a solution!
		4) Assen project	4) So we were proud to be sensor city, that is how it started, anyway.
	I	1) Assen project, awareness	1) <i>Q: Did you know that Assen had tries to implement it [real-time transport information app].</i> I: No, not at all.
		2) Assen project, awareness, citizen participation	2) <i>Q: Were you aware of the sensor city scheme?</i> I: Hmm, well to some extent yes.
		3) Assen project, awareness, citizen participation	3) <i>Q: Would you have liked to have been more informed beforehand and maybe been involved?</i> I: Hmm yeah. I really don't know.
		4) Assen project, negative driver	4) <i>Q: Are you dissatisfied with the current transport system in Assen?</i> I: No not at all but I am hardly using it.

Topic	Person	Code	Quotes
		5) Assen project, negative driver	5) The last mile, when you go from public transport to another place, your house? For me, it isn't [difficult]! I can imagine that for older people it is.

Table 4-10: Interview overview of Costs.

Topic	Person	Code	Quotes
Costs	G1	1) Costs, behavioural costs	1) higher cost for them, behaviour wise, to change.
		2) Costs, behavioural costs, ease of use, disadvantages	2) The digital divide thing could be a problem. Not everyone is familiar with the technology. It can take time to learn how to use it and to feel comfortable using it.
		3) Costs, behavioural costs, ease of use, disadvantage	3) Not everyone with a disability is going to be able or want to use public transport, for certain disabilities, maybe it's less easy for them to get from A to B than in the current situation....MaaS could burden them more than their current system.
		4) Costs, financial aspects, citizen participation	4) But in the end whether it will be big really depends on many other factors amongst which are for instance the costs of the subscriptions, but also on the implementation costs.
		5) Costs, financial aspect	5) But the economical aspects of both the big, expensive, empty busses and the MaaS scheme with a very low user density would have to be weighed up.
		6) Costs, financial aspects	6) If you have a sort of unlimited subscription in Helsinki, I think then you pay more than €300,- maybe €400,- euros a month. That, I think, in essence is not that cheap.
	G2	1) Costs, behavioural costs, ease of use	1) voor mensen met een beperking moet er iets gebeuren om ze te helpen, dus bijvoorbeeld een blind persoon moet gebruik kunnen maken van de dienst. Iemand met een rollator heeft bepaalde kenmerken waardoor de dienst aangepast moet worden. We proberen de mensen erbij te betrekken.
		2) Costs, behavioural costs, financial aspects, scale	2) Tegelijkertijd kan kan die diensten ook wel veel makkelijker maken en misschien ook wel goedkoper als je op grotere schalen afspraken kan maken.

5. Word occurrence during interviews

Table 2: Word occurrence

weight	word
112	MaaS
60	transport
59	people
58	use
53	Assen
37	MAAS
35	traffic
29	project
27	something
26	car
26	platform
25	public
25	system
24	want
23	always
23	need
22	data
22	scheme
22	sensor
22	time
20	Groningen
20	work
19	difficult
19	good
18	concept
18	mensen
18	modes
17	kind
17	now

17	question
17	service
17	vervoer
16	problem
16	sense
15	cities
15	density
15	dienst
15	important
15	mobility
15	place
14	app
14	inhabitants
14	questions
14	station
13	bike
13	bus
13	Drenthe
13	goed
13	implement
13	research
13	verschillende
12	current
12	first
12	integrated
12	municipality
12	network
12	partij
12	successful
12	things
12	transportation
11	case

F. Cawthorne-Nugent

11	general
11	many
11	Netherlands
11	overheid
11	subscription
11	working
11	yes
10	example
10	Helsinki
10	involved
10	new
10	schemes
10	situation
10	technology
10	used
10	wanted
9	clear
9	demand
9	easier
9	information
9	Mobility
9	smart
9	useful
8	areas
8	communicated
8	definition
8	driven
8	organise
8	publiek
8	related
8	zoektocht
7	better
7	cars

7	citizens
7	contact
7	costs
7	digital
7	flows
7	idea
7	implementing
7	interesting
7	issues
7	markt
7	mode
7	money
7	planning
7	provincie
7	region
7	transit
7	werken
6	congestion
6	disadvantage
6	early
6	easy
6	far
6	future
6	group
6	infrastructure
6	multi
6	opportunities
6	order
6	private
6	problems
6	reasons
6	reizen
6	separate

6	small
6	stad
6	supply
6	user
5	accessibility
5	advantage
5	bicycle
5	change
5	characteristics
5	companies
5	company
5	concepts
5	definitely
5	dienstverlener
5	hub
5	implemented
5	internet
5	level
5	management
5	minutes
5	mobiliteits
5	modality
5	move
5	municipalities
5	netwerk
5	providers
5	regional
5	rural
5	scale
5	student
5	success
5	taxi
5	terms

5	together
5	tool
5	whole
5	years
4	accessible
4	advantageous
4	advantages
4	Amsterdam
4	aspecten
4	beperking
4	collaboration
4	communicate
4	compare
4	defined
4	disadvantages
4	driving
4	explorative
4	familiar
4	Good
4	helps
4	hubs
4	implementeren
4	include
4	insight
4	institute
4	inwoners
4	landelijk
4	mile
4	modal
4	options
4	pilots
4	poverty
4	process

F. Cawthorne-Nugent

4	projects
4	responsible
4	self-driving
4	sensorcity
4	Service
4	society
4	solution
4	solve
4	steden
4	structure
4	travel
4	villages
3	aanbesteding
3	attractive
3	betalen
3	completely
3	complicated
3	conditions
3	connection
3	cooperation
3	definitie
3	dependent
3	disabilities
3	divide
3	doel
3	doelgroep
3	drive
3	Dutch
3	economies
3	essence
3	extremes
3	factors
3	fysieke

3	gebied
3	gebruik
3	gebruiker
3	gemeente
3	groups
3	implementation
3	indirect
3	informed
3	inhabitant
3	initiatives
3	investment
3	keten
3	KIM
3	linked
3	literature
3	logistiek
3	monthly
3	multiple
3	necessary
3	negative
3	newspaper
3	opinion
3	organisation
3	owner
3	participate
3	participatory
3	parties
3	pilot
3	places
3	potentially
3	preferences
3	privacy
3	product

3	projecten
3	publieke
3	railroad
3	railway
3	remote
3	resistance
3	responsibility
3	samenwerking
3	sensors
3	societal
3	solved
3	students
3	successfully
3	sufficient
3	tickets
3	train
3	trains
3	transition
3	travellers
3	users
3	voordelen
2	acceptance
2	advertised
2	aiming
2	approach
2	available
2	barriers
2	behaviour
2	benefits
2	cheap
2	circumstances
2	citizen
2	competition

2	connect
2	connections
2	context
2	control
2	convince
2	coordination
2	developed
2	developer
2	diensten
2	direction
2	disadvantageous
2	discount
2	discuss
2	distinguish
2	doelgroepen
2	efficient
2	elderly
2	everyday
2	evolved
2	expensive
2	extreme
2	feasible
2	finished
2	focused
2	gemeenten
2	government
2	Hague
2	Hannover
2	happy
2	Hubs
2	ideas
2	improve
2	initiative

F. Cawthorne-Nugent

2	innovative
2	instances
2	interchange
2	interested
2	introducing
2	issue
2	journey
2	legally
2	levels
2	locations
2	Maas
2	ministerie
2	ministry
2	mobiliteit
2	model
2	nadelen
2	ontwikkeld
2	operational
2	opportunity
2	organised
2	OV-bureau
2	overeenkomst
2	parking
2	partners
2	People
2	person
2	personal
2	Pilot
2	plannen
2	policies
2	polluting
2	popular
2	population

2	possibilities
2	proces
2	projectleider
2	provide
2	province
2	provinces
2	Randstad
2	regio
2	regions
2	reiziger
2	reliant
2	renovated
2	reports
2	residents
2	results
2	road
2	roads
2	route
2	routine
2	sector
2	services
2	sharing
2	shift
2	specifiek
2	team
2	technological
2	theme
2	thesis
2	vehicles
2	wegen
1	access
1	analysis
1	approached

1	approve
1	architecture
1	autonomous
1	availability
1	avoid
1	Birmingham
1	bottlenecks
1	car-share
1	car-sharing
1	carpool
1	challenges
1	City
1	combinations
1	community
1	computerized