

ON BREAKING THROUGH

The ability of Mobility-as-a-Service to promote sustainable transportation

Masterthesis Spatial Planning
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Preface

As a student living in Utrecht, I don't own a car. I don't see myself owning a car in the near future, as are more and more people. Yet our world is totally formed around the car, even though the negative consequences of this are known for a long time. Because I'm interested in mobility and transportation, I started looking for inspiration on the internet for a topic to write my thesis about. I stumbled upon the concept of Mobility-as-a-Service. Initially, I wasn't very fond of the concept, it seemed like a hype. But maybe this hype is worth looking into. After all, the car once was nothing more than a hype, so why can't it be replaced by a hype? This started the six month journey of this thesis.

It is very clear to me that I don't have the final answer to the question if Mobility-as-a-Service will replace the car. But I gained some useful insights and also learned some things along the way. I really enjoyed interviewing the different actors who are involved in the Mobility-as-a-Service programme in the Netherlands. I saw a lot of passionate people who all strive to make a difference, one way or another. This was very inspiring! Thank you to all my respondents for working with me, it was a pleasure. I also would like to thank my supervisor, Yanliu Lin, for helping me along the way. Especially the beginning was very rough. Thank you for providing me with new ideas, I enjoyed working with you! I also would like to thank my parents, roommates and other friends who had to hear me moaning about my struggles. Writing a thesis is not always fun, but thanks to you I was able to find the motivation to continue.

Changing the world around us is a hard task. But I strongly believe that we can and must do something to improve the world (including our mobility system), even though that sounds impossible. I'm not somebody who wants to change the world in one day, but at the university I learned that some revolutionary ideas are the reason we enjoy living in a developed country. So let's continue developing revolutionary ideas, step by step, to make sure that future generations can enjoy living as well!

Christian Stam

Samenvatting

Momenteel is de auto het dominante vervoermiddel. De negatieve effecten hiervan onderstrepen de noodzaak van een duurzamer mobiliteitslandschap. Het concept van Mobility-as-a-Service (MaaS) heeft de belofte om het reisgedrag van mensen te veranderen door alle duurzame vervoersopties in één app te integreren. Hiermee zou de drempel tot het gebruik maken van duurzame vervoersmiddelen verlaagd moeten worden. Maar aangezien MaaS een relatief nieuwe ontwikkeling is, blijft het onduidelijk of het deze belofte kan waarmaken, wat leidt tot de centrale vraag van dit onderzoek: *in hoeverre ondersteunt Mobility-as-a-Service een duurzame mobiliteitstransitie?*

Aan de hand van literatuur en vijf casestudies (Göteborg, Helsinki, Wenen, Assen-Groningen en Utrecht) wordt er onderzocht in welke mate het concept van MaaS bijdraagt aan een duurzame mobiliteitstransitie, af van de auto als voornaamste vervoermiddel. In de internationale casestudies is een documentanalyse uitgevoerd en er zijn interviews gehouden met respondenten uit de Nederlandse casestudies.

De resultaten laten zien dat MaaS nog niet volledig ontwikkeld is. Afgezien van enkele prestaties, zijn er een aantal problemen gevonden. Enkele van de belangrijkste kwesties hebben betrekking op het businessmodel, technische integratie en relaties tussen actoren. Hoewel de relatie tussen de overheid en andere actoren soms stroef is, wordt een ondersteunende rol van de overheid noodzakelijk geacht om MaaS verder te ontwikkelen. Het stellen van kaders voor marktpartijen om binnen te opereren en het ondersteunen van MaaS-ontwikkelingen lijkt de weg vooruit.

Summary

Currently, cars are the dominant mode of transportation. The negative effects of this give urge to the need for a more sustainable mobility landscape. The concept of Mobility-as-a-Service (MaaS) has the promise to change travel behaviour of people by making it easier to use sustainable modes of transportation by integrating them in one digital interface. But since MaaS is a relatively new development, if it can fulfil its promise remains unclear, which leads to the central question of this research: *To which extent does Mobility-as-a-Service support sustainable mobility transition?*

Using literature and five case studies (Gothenburg, Helsinki, Vienna, Assen-Groningen and Utrecht) this study aims to assess to which extent the concept of MaaS contributes to sustainable mobility transition away from the car as the prime mode of transportation. In the international case studies, a document analysis was conducted, while interviews were held with respondents from the Dutch case studies.

The results show that MaaS is not fully developed. Aside from some accomplishments, there are a number of issues found. Some of the most important issues pertain to the business model, technical integration and relations between actors. Although the relations between the government and other actors are sometimes stiff, a supportive role of the government is deemed necessary to further develop MaaS. Setting frameworks for market parties to operate in and supporting MaaS developments seems the way to go forward.

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1. Introduction

1.1. Mobility-as-a-Service and sustainable transportation

During the last five years, the number of displacements in the Netherlands by car on average increased (Centraal Bureau voor de Statistiek [CBS], 2019; CBS, 2021). In 2019, around 70% of the total distance travelled, was made by car (CBS, n.d.). Cars are a source of several harmful emissions for the environment and health. In recent times, there is increasing pressure on governments, international organisations and private companies to develop and deploy more sustainable means of transportation (Expósito-Izquierdo, Expósito-Márquez & Brito-Santana, 2017). Therefore, it is important to look for a more sustainable alternative for cars as the prime mode of transportation. To make it more attractive to travel with more sustainable modes of transportation, the concept of Mobility-as-a-Service (MaaS) can be used (Jittrapirom et al., 2017).

MaaS can be understood as: “a system, in which a comprehensive range of mobility services are provided to customers by mobility operators” (Heikkilä, 2014, p. 8). Already, several digital apps exist to plan for a journey. However, these apps do not include multimodal options (for example: one part of the planned journey by public transport, and one part by car), nor do they have options for using newer modes of transport, like shared cars or bicycles. MaaS is supposed to deliver a convenient mobility solution to substitute the car, by integrating the multiple services in one user interface (Heikkilä, 2014).

There are a couple of pilot projects that ‘pave the way’ for Mobility-as-a-Service, such as a collaboration programme in Sweden or the inclusion of private mobility services in the public national travel planner in Denmark (Smith & Hensher, 2020). Besides these projects, in several countries MaaS pilot projects have been started in the last ten years. In the Netherlands, for example, the Ministry of Infrastructure and Water Management developed seven MaaS pilots, in collaboration with seven regions across the country. In these pilots, the parties involved test what works and what does not work in terms of behaviour, business case (for the provider) and policy impact (Rijkswaterstaat, n.d.). These examples show that MaaS is being developed and implemented in multiple countries. However, because of the relative novelty of the concept, there currently exist no successful, large-scale, implementation of MaaS and it’s not clear for policy makers how to successfully implement MaaS (Smith & Hensher, 2020). In fact, there has been some criticism about MaaS and that it cannot make a big impact on mobility transition (Giesecke, Surakka & Hakonen, 2016). This begs the question if MaaS can indeed fulfil its promise by supporting a mobility transition away from car centred mobility towards more sustainable forms of transportation. This research aims to assess to which extent the concept of MaaS contributes to sustainable mobility transition away from the car as the prime mode of transportation. This leads to the following research question:

To which extent does Mobility-as-a-Service support sustainable mobility transition?

To start answering the research question, it must be clear what a mobility transition is and what the position is of MaaS in this concept. The Multi-level Perspective is used in various fields of research, among which mobility, to explain the various things involved in a transition (Köhler et al., 2009). In order for something to influence a ruling system, it must ‘break through’ (Geels, 2004). The following sub question takes these concepts into regard: *How can Mobility-as-a-Service break through, according to the Multi-level Perspective?*

The Multi-level Perspective alone is insufficient to give an answer to the main research question. Since there are many transport modes involved, there are also many actors involved (Heikkilä, 2014). Therefore, the following sub question is: *What are the relevant actors of Mobility-as-a-Service and the*

relations between them? As this research will show, the relations between actors are important for the development of MaaS.

When looking at the relations between actors, under which the state, the concept of governance comes into view. This research uses a model from Holmberg, Collado, Sarasini and Williander (2016) to evaluate the possible governance approaches. Furthermore, to assess the influence of MaaS on the mobility system, a look into the accomplishments and issues of MaaS is necessary. Governance approaches can influence the performance of public transportation and the general objective to support sustainable mobility (Noto & Bianchi, 2015; Mullin, Feiock & Niemeier, 2020). Since MaaS also strives for sustainable mobility, the link between governance and performance will be explored by the following sub question: *How do different governance approaches affect the accomplishments and problems of Mobility-as-a-Service?*

1.2. Relevance

Car use has negative consequences for the environment. However, in the Netherlands, the car is the prime mode of transportation, as the great majority of distance travelled was made by car, in 2019 (CBS, n.d.). This necessitates the need for a more sustainable mode of transportation. A problem with using a variety of transportation modes is lack of integration. MaaS tackles this problem with its integration of multiple services in one user interface (Kamargianni, Li, Matyas & Schäfer, 2016). With this integration, MaaS lowers the barrier for using sustainable modes of transportation. Making it easier to use sustainable modes of transportation leads to more users, which has positive effects on the environment, reduces congestion and creates economic opportunities (Smith & Hensher, 2020). However, MaaS is not without its critics. Giesecke et al. (2016), for example, describe MaaS as “a loosely connected patchwork of optimistic political dogma, activists' enthusiasm, anecdotal evidence of successful services and a firm belief of investors in companies such as Uber” (p. 1). Indeed, MaaS has several issues that hamper its ability to accomplish a paradigm shift, such as a low number of users which can lead to a low number of mobility service providers and vice versa (Jittrapirom et al., 2017). In order to assess the ability of MaaS to influence the mobility system and to fulfil its promises, it is important to look at the accomplishments and problems of MaaS, which this research will do.

MaaS is not a brand new concept and this research is not the first study done on the topic. The main promise of MaaS is to enable a shift away from the car as prime mode of transportation and towards more sustainable forms of transportation (Jittrapirom et al., 2017; Utriainen & Pollänen, 2018). MaaS therefore is one of the means trying to achieve a shift in the mobility ecosystem. Based on earlier work on transition theory, Geels (2002) developed a model for assessing transitions to sustainable mobility. This model is useful for looking at MaaS. However, this model lacks in recognising the various involved actors in MaaS. Therefore, this research will dive deeper into the aspect of governance.

Governance is a broad topic with a lot of different definitions. Probably the best known approaches to the term governance are the works of Jessop (1998) and Rhodes (2007). These two authors have two fundamentally different approaches to governance. Rather than trying to work out which approach to governance is best, this research combines two core characteristics of these approaches: the role of the state and the importance of interactions (Jessop, 1998; Rhodes, 2007). This is relevant, since governance may have implications for the performance of MaaS. The relation between governance and sustainable mobility objectives and performance of public transportation has been shown by academic studies (Marsden & Reardon, 2017; Mullin et al., 2020; Noto & Bianchi, 2015). Since MaaS also fits within the objective of governments for a more sustainable transportation sector, and public transport

forms a part of MaaS, governance approaches may influence the performance of a MaaS pilot. This relation has not been proved or disproved yet, so this research provides a relevant new perspective.

By combining the Geels (2002) model with the six governance approaches proposed by Hirschhorn et al. (2019) and looking into the accomplishments and problems of MaaS, this research gives a new perspective on the concept and its (in)ability of changing the mobility landscape.

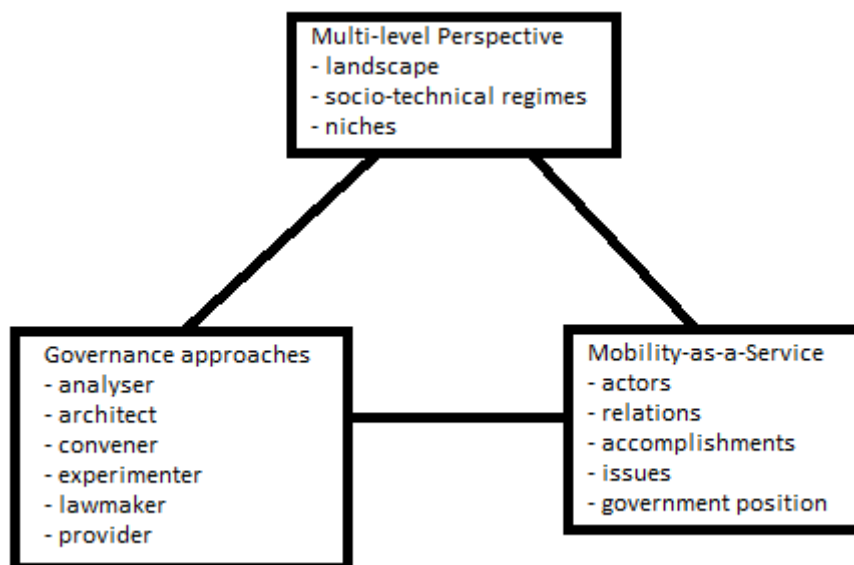
1.3. Structure of the research

The research is structured as follows: after the introduction, the relevant scientific literature will be presented, because it forms the basis for the research. In chapter three, the methods of the empirical research will be explained and choices justified. Next, the results of the content analysis of the three international case studies will be presented. In chapter five, the interviews of actors of two Dutch case studies will be presented. Chapter six forms the discussion part, where the results of the empirical research will be combined with the found scientific literature. The conclusion forms the answer to the main research question as well as a reflection of this study.

2. Theoretical framework

In summary, this theoretical framework seeks to explore the link between the Multi-level Perspective, the governance approaches to MaaS and the accomplishments and problems of MaaS. The concept of MaaS is a relatively recent development within the passenger mobility system. The move away from car-centred mobility has many dimensions, to which the Multi-level Perspective offers a perspective (Köhler et al., 2009). For MaaS to influence the mobility system, it must be fully developed (Geels & Schot, 2007). The Multi-level Perspective, however, does not provide an explanation for the relations between actors. Therefore, the concept of MaaS needs to be examined. Using the model of Holmberg et al. (2016) gives a good picture of the different actors involved, but the position of the state in relation with non-state actors deserves special attention, since the state is an important actor. Therefore, a look at governance literature is necessary. According to Hirschhorn, Paulsson, Sørensen and Veeneman (2019) the relation between the government and MaaS can be characterised in six approaches. Based on these, it becomes clear that the state is a relevant actor in MaaS, but that interaction and interdependence between actors is important too (Hirschhorn et al., 2019). Another element of the impact of MaaS on the mobility system is the accomplishments seen in MaaS projects and the issues of MaaS. What the preferred position of the government is in this element, is a topic of debate. This leads to the empirical research in the next chapter. The framework, summarised in this section, is illustrated in Figure 1.

Figure 1: Conceptual model

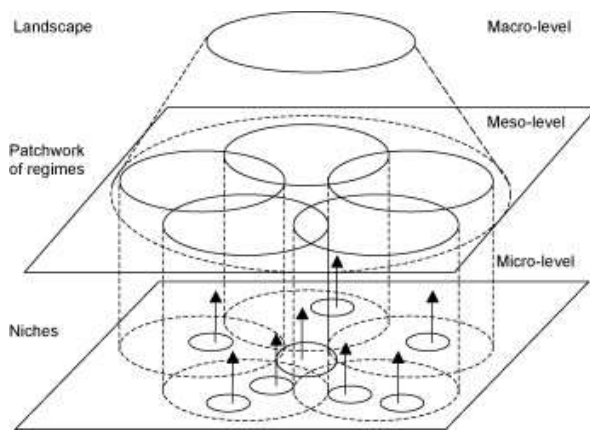


2.1. Multi-level Perspective

2.1.1. Explaining the framework

The main goal of MaaS is accomplishing a transition in the mobility system by reducing the use of the car as prime mode of transportation and increasing the use of sustainable forms of transportation, by integrating multiple transportation modes in one digital interface (Heikkilä, 2014; Jittrapirom et al., 2017). Such a mobility transition is quite complex and involves different dimensions. The Multi-level Perspective (MLP) offers an encompassing lens on the developments in a system, such as the mobility system. It delivers an explanation on how a system transition works, while taking multiple dimensions into account (Köhler et al., 2009). MLP consists of three levels, as can be seen in Figure 2.

Figure 2: Multi-level Perspective framework



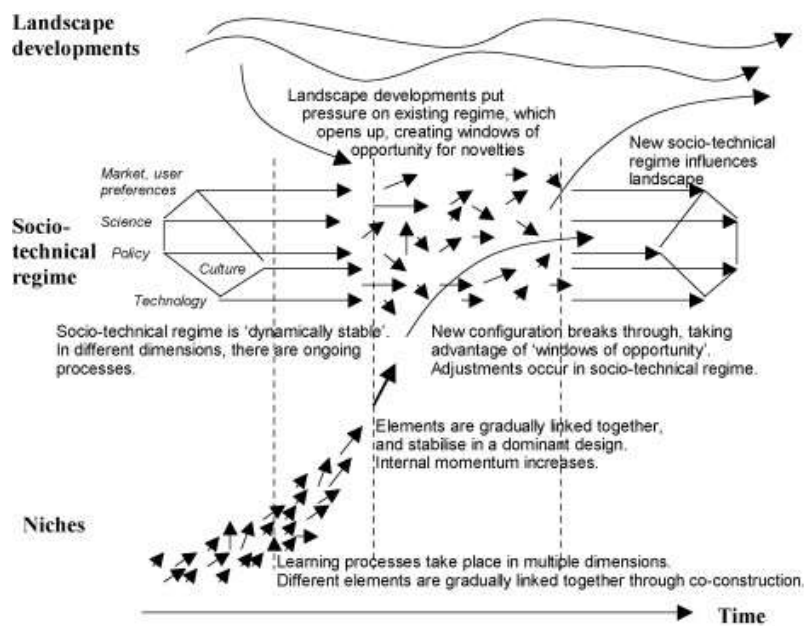
Source: Genus & Coles (2008)

The macro level is that of the *landscape*. This landscape consists of multiple, structural trends, such as economic growth, emigration or environmental problems. A landscape is 'rigid': it does change, but it is slow to do so. The meso level is that of *sociotechnical regimes*. These are a 'semi-coherent' set of rules followed by different social groups. These groups can include the engineers of a technological product, the users of that product, the scientists, policymakers etc. A sociotechnical regime is less rigid than a landscape and incremental changes and innovations can occur. Radical innovations occur at the micro level, the *niches*. These are protected spaces in which learning processes can take place and social networks can be built to support the innovations (Geels, 2002). These innovations are developed and carried out by a small network of dedicated actors (Geels & Schot, 2007). Radical innovations in niches influence sociotechnical regimes, which have an impact on the landscape (Geels, 2002). Figure 3 depicts the process of system innovations. In brief, under tension, a successful innovation can 'break through' when there is a 'window of opportunity' and make changes to the sociotechnical regime (or even replace it). After a period of fluctuation, eventually new sociotechnical regimes are formed, which may influence landscape developments (Geels, 2004). This can only happen when a niche is fully developed, however. It is very difficult to objectively determine when a niche is fully developed, but there are four proxy indicators for when a niche is viably to break through:

- Learning processes have stabilised in a dominant design;
- Powerful actors have joined in the support network;
- Improvement of price/performance improvements, with expectations of further improvement;
- The innovation is used in market niches.

When a niche is not fully developed, it does not have the capability of breaking through when a window of opportunity arrives (Geels & Schot, 2007). Since MaaS is a development within the mobility system promising to accomplish a system transition, the question becomes what position it has in this system and how it can influence this system.

Figure 3: Multi-level Perspective on innovations



Source: Genus & Coles (2008)

2.1.2. The position of Mobility-as-a-Service in the Multi-level Perspective

When MLP is applied to the mobility system, the following remarks can be made. The *landscape* is the broader passenger mobility system. This landscape is not rigid, but trends like environmental concerns or the rise of the sharing economy destabilise the land passenger mobility system (Hirschhorn et al., 2019; Marsden & Rye, 2010).

The landscape consists of multiple *socio-technical regimes*. One of them consists of the type of mobility, where the car holds a dominant position. Other regimes include the people in the mobility system (commuters or travellers), the governments mobility policies or the transport providers. Each regime has multiple dimensions. For example, the dominant position of the car has functional, symbolic and societal frames. For an innovation which wants to replace the car as the dominant type of mobility, it must successfully challenge certain frames, for example the frame in which owning a car is a status symbol (Sovacool & Axsen, 2018).

An innovation like electric vehicles or the concept of MaaS is a *niche* in the mobility system (Hirschhorn et al., 2019). Trends like environmental concerns and the rise in popularity of the shared economy and flexibility of lifestyle create a window of opportunity for changes to the mobility system. MaaS has the potential to seize this opportunity with its focus on sustainability, flexibility and its use of technology and shared mobility (Sharmeen & Meurs, 2019). According to Geels and Schot (2007), as stated before, in order for MaaS to successfully seize this window of opportunity, it must be fully developed. This circles back to the main research question, because is MaaS able to seize this window of opportunity and make changes to the mobility system?. Using MLP alone is insufficient to give a definitive answer, because one of the critiques on MLP is that it is unable to conceptualise the role of actors and interactions in transitions. Especially, the role of the state is unclear and needs further research, to which a look at governance is important (Johnstone & Newell, 2018; Hirschhorn et al., 2019). Furthermore, the concept of MaaS with its actors needs to be discussed in order to better be able to answer the research question.

2.2. Mobility-as-a-Service

2.2.1. Definitions and characteristics

Multiple definitions of MaaS exist, covering different aspects. For example, Heikkilä defines MaaS as: “a system, in which a comprehensive range of mobility services are provided to customers by mobility operators” (2014, p. 8). Heikkilä’s definition is quite broad and mainly concerns the different transportation options a customer can choose from. Vij and Dühr (2022) offer a more comprehensive definition of MaaS, based on work of other authors: “Maas systems offer consumers access to multiple transport modes and services, owned and operated by different mobility service providers, through an integrated digital platform for planning, booking and payment” (p. 3). In this definition, the user interface is an important aspect of MaaS. Holmberg, Collado, Sarasini and Williander (2016) focus on a subset of MaaS (Combined Mobility Services), what they define as “a more strict description of a service offering containing several transport modes offered in one subscription/service offering to the customer” (p. 9). This definition, combined with the definition of Vij and Dühr (2022) places an emphasis on the MaaS as an ‘easy to use’ concept. Indeed, this view can be supported by work from other authors, such as Jittrapirom et al. (2017) who describe MaaS as essentially ‘user-centric’ with MaaS as a flexible, on-demand and personalized form of mobility service.

Based on the previous mentioned definitions of MaaS, core characteristics of MaaS are the following:

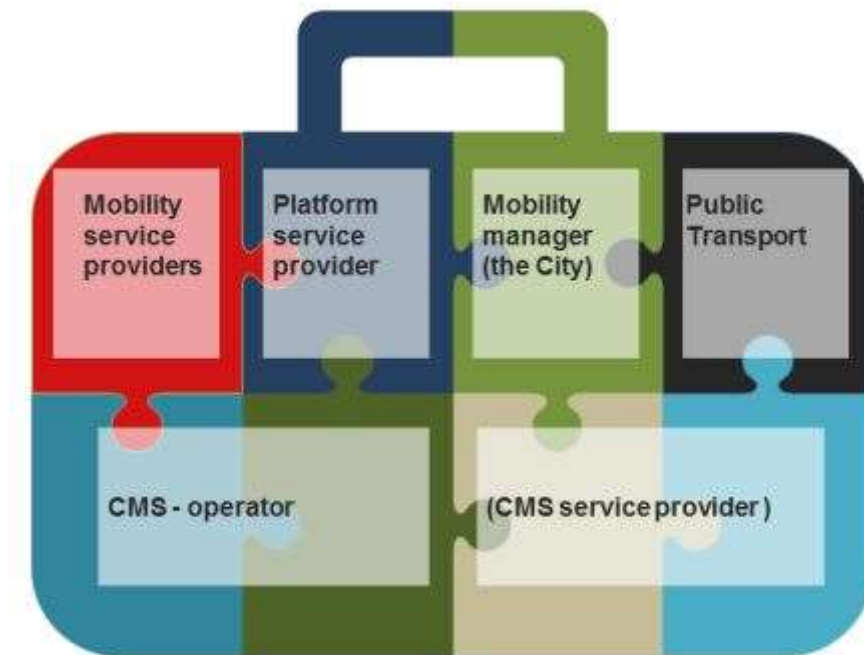
- Mobility services are provided by transport operators and these different services are presented to the user (Heikkilä, 2014);
- Through this digital interface, a user can plan, book and pay for the journey (Vij & Dühr, 2022);
- Using this interface sometimes requires a subscription service with a monthly payment (Holmberg et al., 2016);
- MaaS includes shared mobility services (Kamargianni et al., 2016);
- MaaS is in essence user-centric (Jittrapirom et al., 2017).

Even though in theory a set of characteristics can be defined, in practice there are multiple ‘levels’ of integration in MaaS. For example, in the Netherlands, the national rail operator NS has the NS Business Card, which integrates rail travel with other means of public transport (of other operators), taxi and some shared bicycles. The NS Business Card has limited integration of other means of transport and offers no mobility package integration. Like the NS Business Card, there are multiple products and services that have some characteristics of MaaS but do not fit all (Kamargianni et al, 2016). Therefore, this research only looks at the most advanced cases of MaaS, which fit all the above mentioned characteristics. However, because there is no universal definition of MaaS, some slight variations exist. One of the core characteristics of MaaS is always present, though, and that is the involvement of multiple actors (Heikkilä, 2014).

2.2.2. Involved actors

To get a clear overview of the actors involved in MaaS, the model of Holmberg et al. (2016) is used, which is shown in Figure 4. They mention MaaS as a type of Combined Mobility Service (CMS), which the authors see as an eco-system. In this eco-system, actors combine services from their existing core business into a whole, which is the CMS.

Figure 4: Actors in the MaaS eco-system



Source: Holmberg et al. (2016)

The first actor in the eco-system is the CMS service provider. This is the ‘leader’ of the eco-system and has the objective to scale and grow the eco-system, in other words the CMS service provider is the initiator of the eco-system. It requires CMS operators to ensure that CMS offerings are provided and managed locally¹. Together they are responsible for the success of the CMS offerings. CMS operators collaborate with mobility service providers. These are the companies behind transport modes e.g. car rental or shared bicycle companies. Public transport could also be seen as a mobility service provider, but Holmberg et al. (2016) argue that it deserves to be regarded as a separate actor because of its role. This is mainly because of the ‘merit good’ that public transport provides.

A merit good is “a commodity, which is judged that an individual or society should have on the basis of some concept of need, rather than ability and willingness to pay” (Holmberg et al., 2016, p. 27). According to economist Richard Musgrave, this poses a problem for all public services, public transport included. The general public does not always know what is good for them. They can lack relevant information or do not have access to right information, or face the ‘tragedy of the commons’. A merit good is thus better for the public than the public knows themselves. As such, the merit good has a cost which is higher than the public wants to pay for (Hardin, as cited in Holmberg et al., 2016; Musgrave, 1956).

Public transport has multiple positive effects, such as reduction of harmful emissions and congestion, compared to private car use. However, the high costs of public transport cannot be covered by ticket sales alone, because the public is not willing to pay the total cost. Therefore, in almost all cases, a public transport agency must receive subsidies from the government. This is the mobility manager in the eco-system. A mobility manager can be either local, regional or national. Lastly, a platform service provider manages all the services offered by mobility service providers through a digital platform (Holmberg et al., 2016). This digital platform is the app used for accessing, booking and paying for MaaS services.

¹ Initially, the CMS provider is also the CMS operator.

2.3. Governance approaches to Mobility-as-a-Service

As the Holmberg et al. (2016) model shows, MaaS has multiple actors involved, both government and market actors. This means that for MaaS to be successful, the involved actors must find a way to work together. To get a better insight in this topic, the term of governance will be explained. Governance is a broad term with many interpretations. This research focuses on two approaches to governance. The first approach is the political economy approach, based on the work of Jessop. In short, Jessop (1998) argues that governance is the third way between the market on one side and strong state hierarchy on the other side. The nation state still has an important role in meta-governance processes. The governance-as-networks approach of Rhodes (2007) has a different perspective. According to this approach, governance means interdependence between organisations, beyond governmental actors, with continuous interaction between network members and interactions, rooted in trust and regulated by rules, which the network members negotiated and agreed upon. Thus, it becomes clear that on one hand, the state is still an important actor, like Jessop (1998) argues, but on the other hand, interactions and interdependence between actors (both state and non-state) is important, according to the governance-as-network approach of Rhodes (2007). However, these broad approaches to governance do not give an explanation on how the relations between actors in MaaS developments can look like. Hirschhorn et al. (2019) come up with six governance approaches related to MaaS developments. They base their approaches on three case studies of MaaS developments in Amsterdam, Birmingham and Helsinki. These approaches are: analyser, architect, convener, experimenter, lawmaker and provider.

Analyser

Conducts scoping activities. An analyser primarily wants to seek knowledge and collect evidence by following initiatives. The goal is to be able to intervene in the free market if that is deemed necessary. In the case of Birmingham, the UK's Department for Transport (DfT) approaches the MaaS project in the West Midlands as analyser. The DfT collects evidence and learns from the experiences in order to choose to advise the government if and how to govern the development of MaaS. The attitude of the DfT is described as scoping and hands-off, not interfering in task implementation (Hirschhorn et al., 2019). In light of the earlier mentioned Multi-level Perspective, an actor with an *analyser* approach is a regime actor (Geels & Schot, 2007)

Architect

An architect is enabling niches by *framing policies and resources and setting broad goals*. Other (contracted-out) network actors are carrying out tasks and they have freedom to act within set policy and financial frames. In Amsterdam (Amstelland-Meerlanden), the Public Transport Authority (PTA) equips its concession with a Schedule of Requirements. In this way, the PTA sets its general policy objectives and requirements of what it expects from bidders in the MaaS project. The operator that wins the bid then has the freedom to design and operate within this policy and financial framework (Hirschhorn et al., 2019). An *architect* is a niche enabler and transitional actor, operating at the regime level (Geels & Schot, 2007).

Convener

Enables niches by *helping to build relationships and networks*. A convener is supporting and mediating in the dialogue and collaboration between actors and seeking solutions that are mutually acceptable. It relies on free market incentives for parties to come up with solutions, but ensures that these are aligned with societal goals. In Birmingham, the PTA directly influences the trajectory and outputs of the MaaS pilot, by promoting relationships between actors, to ensure that the trajectory and outputs are aligned

with targeted societal goals. A *convener* enables niches and is a transitional actor, operating at regime and niche levels (Hirschhorn et al., 2019).

Experimenter

An experimenter is also trying to enable niches, but uses a more hands-on approach. As the name implies, an experimenter mainly aims to *seek knowledge by learning-by-doing*. Other (contracted-out) network actors are carrying out tasks, but the outputs have to follow detailed guidelines. The Zuidas pilot in Amsterdam is quite similar to the Amstelland-Meerlanden case, but the approach of the PTA is more active. It determines specific solution requirements: certain core functionalities of MaaS must be present in the pilot. The pilot is used as a living lab: to learn from the experiences in order to enhance knowledge on how to respond to MaaS in the long-term. This approach is seen as temporary from the start. The definitive role of the government is to be defined after in-depth experience is gained from MaaS. *“In this role, the Dutch Ministry employs strong hands-on intervention (...) to determine the direction of MaaS pilots. Tasks are to be carried-out by other network actors, moved by economic interests, but according to strictly defined guidelines”* (Hirschhorn et al., 2019, p. 185). By aligning the agendas of the different actors and by defining precise guidelines to determine the output and trajectory of the niche, the *experimenter* intervenes directly at niche level (Hirschhorn et al., 2019).

Lawmaker

Enables niches by *using regulation as the instrument to (re)design the institutional setup of the mobility system in order to allow market forces to drive innovation*. The Finnish Ministry influences the development of MaaS through strategy documents supporting innovation in transportation and by the new Transport Act. The implementation of this act is left to other actors, but this is an example of a strong intervention because of its detailed and coercive prescriptions. A *lawmaker* refrains from direct involvement in a MaaS niche, but operates and exerts power from the regime level (Hirschhorn et al., 2019).

Provider

A provider *mobilises resources to design and offer desired solutions, ascertaining a leadership position*. For example, in a changing mobility landscape, a provider maintains or recovers the original power balance. In response to legislative changes, actions by the Helsinki PTA involve strong hands-on intervention of the development of MaaS. This involves a movement of re-orientation with the aim of securing a leadership position in the public transport ecosystem. Helsinki's PTA intervenes directly in MaaS implementation and definition of outputs. Lastly, a *provider* operates both at the niche and regime levels and seeks to restrain competition between niche solutions and regime (Hirschhorn et al., 2019).

Based on the governance approaches discussed in this paragraph, it becomes clear that the state is a relevant actor in MaaS, operating at both the niche and regime levels (Jessop, 1998; Hirschhorn et al., 2019). Furthermore, good interaction and interdependence between actors is important in MaaS (Rhodes, 2007). It can be stated that based on the views of Rhodes (2007), some of the governance approaches mentioned by Hirschhorn et al. (2019) can also be performed by an actor other than the state, like the convener approach, in which an actor helps building relationships and networks. Research on this topic is limited. For example, Smith et al. (2018a) have indicated that non-state actors play an important role in the development and diffusion of MaaS, but also state that further research needs to be done. Another example is provided by the research of Oldbury (2021) on the roles and responsibilities of different actors involved in the introduction of MaaS and driverless shuttles in Barkarbystaden, Sweden. Especially the relationship between operators and public transport agencies is deemed

important in the development of new innovations, such as MaaS or driverless shuttles, but Oldbury (2021) highlights the need for further study. Therefore, it is not possible to draw definitive conclusions yet based on the literature.

2.4. Accomplishments and issues of Mobility-as-a-Service

Before conducting empirical research on the governance approaches in MaaS pilots, it is important to first take a look at the accomplishments and issues associated with MaaS. The accomplishments and issues are related to the actors or relationship between actors in MaaS developments (e.g. Mulley et al., 2018; Vij & Dühr, 2022) and therefore will be examined in this paragraph.

2.4.1. Accomplishments of Mobility-as-a-Service

Even though MaaS has not been broadly implicated, already some accomplishments can be seen from trials and small-scale projects. One of the promises of MaaS is to fulfil mobility needs without having to own a private car, or having to use various tickets of mobility service or public transport operators (Ambrosino, Nelson, Boero & Pettinelli, 2016; Giesecke et al., 2016). This has been proved to be the case, albeit limited, in a MaaS trial in Gothenburg, Sweden. During the trial, use of private car has dropped by 50% and use of several complementary mobility services (e.g. car sharing or local public transport) has increased (Sochor, Karlsson & Strömberg, 2016).

Another accomplishment of MaaS is that it provides new opportunities for elderly and disabled persons to travel. Conventional public transport is not always convenient because of varying frequencies and fixed time schedules (Atasoy, Ikeda, Song & Ben-Akiva, 2015). Furthermore, conventional public transport has several accessibility issues (Park & Chowdhury, 2018). While taxis provide greater convenience, they are also more expensive (Atasoy et al., 2015). MaaS offers greater flexibility and personalised travel options, with better price offerings (Melis, Prandini, Sartori & Callegati, 2016). A small study found perceived cost savings, ease of use, usefulness and intention to use MaaS to be positive (Mola, Berger, Haavisto & Soscia, 2020).

Evidence on the accomplishments of MaaS is limited, however (European Commission, as cited in Mulley, Nelson & Wright, 2018). Some other expected advantages of MaaS, relating to mobility, include the improved effectiveness of the whole transportation system, due to the increase in flexibility, and improved reliability. MaaS also provides market opportunities for new types of transport services as well as 'renewed opportunities' for existing transport and infrastructure business sectors as part of innovative service concepts and cooperation (Mulley et al., 2018).

2.4.2. Issues with Mobility-as-a-Service

Some authors call for a strong role of the government in MaaS, because of some problems concerning MaaS (Vij & Dühr, 2022; Ambrosino et al., 2016; Hensher, Mulley & Nelson, 2021). Therefore, it is relevant to look at those issues and the reason why a hands-on governance is preferred.

Business models

The first main issue concerning MaaS is strongly related to its business model. As has been mentioned in the model of Holmberg et al. (2016), a platform provider manages a digital platform for the offering, booking and payment of various mobility services. Therefore, a platform provider needs to attract multiple operators to their platform. Thus, in brief, the success of a MaaS pilot hinges on the success of the platform provider to convince mobility service providers to join the platform. Therefore, a MaaS pilot must have sufficient commercial value, with a sound business model. Vij and Dühr (2022) describe two business models which will be shortly explained here.

In the first business model, MaaS is provided by a third party as a platform provider and mobility broker. The platform provider will have to make commercial arrangements with each operator, for example by requiring a mobility service operator to pay a transaction fee for services accessed through the platform. This leads to hesitation from both larger and smaller mobility service operators, which will be explained shortly. The second business model is an operator-led MaaS platform. When a large mobility service operator is the platform provider, it gives the operator control over what other services are provided on the platform. In this instance, a platform can serve as a 'walled garden' for the transport operator, according to Vij and Dühr (2022).

The main issue of the first business model is the commercial viability. Large transport operators are hesitant to be on the same platform as their (potential) competitors. For example, taxi services are weary of ride share services on MaaS platforms, because it can potentially reduce customers for taxi services. On the other hand, even though MaaS platforms provide an opportunity to expand, smaller transport operators are hesitant to being the 'first mover', because they often lack enough capital and technological capability. Another issue with a broker-led platform is the low profitability and cost recovery, because transport operators have to share some of their revenue with the platform provider (Vij & Dühr, 2022). Hensher et al. (2021) support this by stating that in a broker-led model, when shared revenue is low, operators are unwilling to bear the costs: "*If there is no profit, how can its spoils be shared?*" (p. 154).

While the commercial viability of operator-led MaaS platforms is higher (and therefore requires less government support), the platform provider is often reluctant to integrate other large transport operators on the platform for fear of competition. Because of this 'walled garden', a MaaS platform can serve as a way of consolidating a monopoly position of a certain transport operator. This, in turn, can have negative societal outcomes (Vij & Dühr, 2022). For example, in major American cities, up to 12% of total Vehicle Miles Travelled (VMT) was done by ride share services Uber and Lyft (Balding, Whinery, Leshner & Womeldorff, 2019). This could lead to more congestion and higher emissions, because less people travel with public transport (Vij & Dühr, 2022).

Interoperability

An important component of MaaS is its inclusion of and interoperability with different mobility services (Heikkilä, 2014; Giesecke et al., 2016; Sakulyeva, 2020). This has some advantages for the user. For example, MaaS is better in delivering door-to-door trips than public transport (Giesecke et al., 2016). Integration on a MaaS platform has benefits for transport operators as well, for example the sharing of data and computing services or an improved offer of their own services (Ambrosino et al., 2016). Interoperability requires the sharing of data and this can be challenging, since the data is heterogenous and generated from different sources. From a technological point of view, this requires an Application Programming Interface (API) which is capable of enabling interoperability and which provides access to data which is needed to deliver information on mobility related services (Anthony & Petersen, 2019). This research does not want to go into further technical detail, but technical information behind MaaS can be found in work by Anthony and Petersen (2019).

Interoperability requires that the mobility service operators share data with the platform provider. In some cases however, operators are unwilling to do that. For example, taxi companies see ride services like Uber as a threat, because those services take customers away (Smith, Sochor & Karlsson, 2018b). A different study also found that private transport operators and other private companies were unwilling to share their data. This, in fact, was seen as the strongest operational/technical barrier for MaaS

(Polydoropoulou, Pagoni & Tsirimpa, 2020). Because of the importance of interoperability in MaaS, a lack of cooperation and sharing of data can be seen as a serious issue.

Other issues

A societal concern of MaaS has to do with equity. Especially amongst senior rural populations, complete digital literacy cannot be assumed. However, when people do not have a smartphone or are not able to use one it is not possible for them to access MaaS services (Hensher et al., 2021). Besides access to MaaS services, another societal concern is technological determinism. Here, negative consequences of new technologies, such as MaaS, are seen as inevitable, because of a neglect for the complexity of transitions, which could cause social issues. In combination with the strengthening of lower levels of self-government, increasing diversity of governance and the exposure of the public domain to market forces, this technological determinism could lead to political pressure to create streams of revenue from MaaS (i.e. through the selling of shared data). Negative societal and environmental effects are seen as 'unintended consequences' (Polydoropoulou et al., 2020; Pangbourne, Mladenović, Stead & Milakis, 2020).

A financial issue with MaaS is pertaining to public transport. Several authors state the important role of public transport in MaaS (see Hensher et al., 2021; Giesecke et al., 2016; Utriainen & Pöllänen, 2018 amongst others). A well-functioning public transport system is one of the conditions for implementing MaaS, according to Sakulyeva (2020). Public transport systems must receive subsidies to cover all the costs, especially during the COVID-19 pandemic with strictly limited ridership (Hensher et al., 2021; Holmberg et al., 2016). Like mentioned before, this can lead public transport operators to be hesitant to invest in and cooperate with MaaS projects (Vij & Dühr, 2022).

Ultimately, MaaS has a very user-centric approach (Jittrapirom et al., 2017). For the 'end-user', MaaS needs to be *"easy to plan, book and pay, as well as seamless during the actual trip, integrating all transport means and systems, using real-time data, and responding to a broad range of individual user priorities"* (Giesecke et al., 2016, p. 2). Giesecke et al. make a model of the convenience and cost of transport modes included in MaaS from an end-user perspective. MaaS services should offer higher convenience for a lower cost than 'traditional' services. It becomes clear from studies by Holmberg et al. (2016), Jittrapirom et al. (2017) and Vij and Dühr (2022) that convenience is an important aspect of MaaS: by offering 'easy to use' sustainable mobility services, the promise is to reduce car usage. This raises the question: what is the added value of MaaS for the end-user? Journey planner apps, such as Google Maps, offer live directions, an overview of different kinds of services (i.e. public transit, Uber and shared vehicles), and facilitate most transactions for most travel modes (in the case of Google Maps: via Google Pay). If the end-user, therefore, cannot be convinced of the improved convenience of using a MaaS app, he/she will potentially not make use of it (Giesecke et al., 2016; Sakulyeva, 2020; Hensher et al., 2021).

2.4.3. Role of the government

As a result of some of the mentioned issues of MaaS, some authors argue that the government should take a stronger position. First the concerns pertaining to the business model of MaaS. The profitability of MaaS in a broker-led model is uncertain and therefore extensive government subsidising is needed (Vij & Dühr, 2022; Hensher et al., 2021). Thus, it could be argued that an operator-led model is better, since it requires less financial support. A major downside of an operator-led model, however, is the potential for negative societal consequences as a result of the operator using the MaaS project as a means of establishing a monopoly for itself (Vij & Dühr, 2022). Fear of competition is one of the reasons why interoperability between transport operators and the MaaS provider.

A pro-active, strong role of the government is preferred by some authors to combat the abovementioned problems and to increase the efficiency of MaaS (Vij & Dühr, 2022; Hensher et al., 2021; Pangbourne et al., 2020). To combat equity issues, engagement by the state in the designing of goals, subsidies and pricing structures, coverage and consumer protection is seen as important (Pangbourne, Stead, Mladenović & Milakis, 2018). In a study of MaaS developments in Stockholm, Sweden, it was found that involvement of the local government was seen as desirable by stakeholders in facilitating and supporting MaaS developments. The study also suggested government involvement on higher government levels to support diffusion and upscaling (Fenton, Chimenti & Kanda, 2020).

On the other hand, not all authors support a strong government position. Ambrosino et al. (2016) argue for a central role of the Public Transport Agency and do not mention the role of the government. In fact, as illustrated by the term technological determinism, a hands-on governance approach may not be desirable or feasible in a market-led public domain, with increasing amounts of self-government and diversity of governance (Polydoropoulou et al., 2020; Pangbourne et al., 2020). Pangbourne et al. (2018) recognise this by stating that the role of the government should be discussed when addressing the fundamental mobility needs of citizens.

2.5. Summary

This theoretical framework investigated the link between the Multi-level Perspective, the governance approaches to MaaS and the accomplishments and problems of MaaS. The promise of MaaS is to accomplish a system transition in the mobility sector (Jittrapirom et al., 2017). The MLP shows that there are multiple dimensions to a system transition. For a niche, such as MaaS, to break through and change the mobility landscape, it must be fully developed (Köhler et al., 2009; Geels & Schot, 2007). The MLP does not give precise indicators for when MaaS is fully developed and does not take actors and their relations into account. A deeper look into the concept of MaaS shows that there are a lot of definitions. Based on several definitions, the main characteristics of MaaS are:

- Mobility services are provided by transport operators and these different services are presented to the user (Heikkilä, 2014);
- Through this digital interface, a user can plan, book and pay for the journey (Vij & Dühr, 2022);
- Using this interface sometimes requires a subscription service with a monthly payment (Holmberg et al., 2016);
- MaaS includes shared mobility services (Kamargianni et al., 2016);
- MaaS is in essence user-centric (Jittrapirom et al., 2017).

Although some ambiguities exist in what MaaS is defined as, one of the constant characteristics involve the involvement of multiple actors (Heikkilä, 2014). Holmberg et al. (2016) develop a model for the MaaS ecosystem with its actors. Beside the more distant operator and service provider of the so-called Combined Mobility System, the actors 'close to the ground' are the mobility service and platform service providers, the mobility manager (often a government body) and public transport operators. The relations between actors is important for MaaS, particularly the relation between the government and market actors, which brings governance into view. Based on the works of Jessop (1998) and Rhodes (2007) it becomes clear that on one hand, the state is still an important actor, but on the other hand, interactions and interdependence between actors (both state and non-state) is important too. The relation between the government and market actors is categorised into six governance approaches by Hirschhorn et al. (2019). These approaches are: analyser, architect, convener, experimenter, lawmaker and provider. The approaches show a variety in the role of the government, from strict regulation to leaving market parties free to operate. Related to the actors and their relations are the accomplishments and issues of MaaS

(e.g. Mulley et al., 2018; Vij & Dühr, 2022). These are summarised in Table 1. Based on the issues of MaaS, some authors argue for a strong, hands-on involvement of the government (Vij & Dühr, 2022; Ambrosino et al., 2016; Hensher, Mulley & Nelson, 2021), while others argue against this (Polydoropoulou et al., 2020; Pangbourne et al., 2018). This leads to the empirical research part of this study, but first the methods will be explained.

Table 1: Accomplishments and problems of MaaS summarised

Accomplishments	Problems
<ul style="list-style-type: none"> Reduction in car use and increase in use of other (sustainable) transport modes (Sochor et al., 2016); New opportunities for elderly and disabled persons to travel (Melis et al., 2016; Mola et al., 2020). 	<ul style="list-style-type: none"> Business model/finance related issues (Vij & Dühr, 2022; Hensher et al., 2021); Poor technical integration (Anthony & Petersen, 2019); Poor interoperability, due to lack of trust or competitiveness (Smith et al., 2018b; Polydoropoulou et al., 2020); Accessibility issues (Hensher et al., 2021); Technological determinism (Polydoropoulou et al., 2020; Pangbourne et al., 2020); Too little added value compared to other mobility services (Giesecke et al., 2016; Sakulyeva, 2020; Hensher et al., 2021).
<p>Expected benefits</p> <ul style="list-style-type: none"> Improved effectiveness and reliability of the whole transportation system; Market opportunities for new types of transport services as well as ‘renewed opportunities’ for existing transport. <p>(Mulley et al., 2018)</p>	

3. Methods

3.1. Research scope and design

The aim of this research is to investigate the different roles of and relations between involved actors in the concept of Mobility-as-a-Service, as well as how these relations respond to the accomplishments and problems of Mobility-as-a-Service. The research revolves around the following question:

To which extent does Mobility-as-a-Service support sustainable mobility transition?

In order to be able to answer this research question, first a literature review is conducted. Here, relevant concepts are discussed. From the literature study, MaaS has been placed in the context of a system transition. Also, the concept of MaaS is explained with the relevant actors. A model for governance approaches is used and accomplishments and problems of MaaS have been found. However, these concepts on their own are not able to give a meaningful answer to the research question. For example: according to the MLP, a niche can break through when it is fully developed (Geels & Schot, 2007). But what does that look like in practice? And is there any relation between the performance of a MaaS pilot and the governance approach from the government? Therefore, in order to give a meaningful answer to the research question, it is important to conduct empirical research. For the empirical research, this study looks at multiple case studies, because of the fact that the generalisability of insights in a particular case study is limited (Smith, Sarasini, Karlsson, Mukhtar-Landgren & Sochor, 2018a).

In short, the empirical research is conducted from an inductive viewpoint: the concepts found in the literature review (which can be marked as 'theory') are being tested in practice. Since actors are important for MaaS and there are a lot of different actors involved (Holmberg et al., 2016), this research is done from the viewpoint that the reality of one individual differs from the reality of another individual. Therefore, it is not possible to construct an objective truth (Bryman, 2012). Because of this, this research turns to a qualitative form of empirical research. The research uses a mixed methods approach: the two Dutch case studies involve semi-structured interviewing, while the three international case studies involve further literature review. The Dutch case studies are still ongoing and will be finished at the end of 2022 (Personal correspondence). Therefore, academic research on these case studies is limited. Furthermore, since there are several different actors involved and this research has an emphasis on relations between actors, interviewing is the method of choice. The interviews are semi-structured in nature and follow a topic list (see Appendix 1). It is important that the research can be replicated, so a standardised list of questions is asked for. However, on the other hand, flexibility is important, since there are several different actors involved, so standardisation is difficult (see paragraph 3.3 on respondents). To find a balance between standardisation and flexibility, a semi-structured interview approach is chosen (Bryman, 2012). Although the topic lists vary per interviewee in some degree, in general all the topics from the literature review are present in the interview guides. In total, around six key questions were asked, but sometimes had follow-up questions depending on the answer of the respondent. A few examples of key questions are:

- *Why did you decide to participate in this pilot?* This is an introductory question with the purpose to clarify why actors decided to join a MaaS pilot and what their goal is.
- *How do you think the cooperation between you and the other parties involved is going?* This question relates to the relations between involved actors and to the problem of poor integration between actors, as found in the literature.
- *What do you think is the added value of the MaaS concept?* This question relates to the problem of low added value, as has been stated in the literature section.

- *How can the national government respond to the strengths and weaknesses of MaaS?* With this question, the purpose is to get more clarity on how actors think about the position of the government in future MaaS developments.

In total, nine interviews have been conducted, which had a duration of around thirty minutes on average. All of the interviews were held via Microsoft Teams, except for the interview with a respondent from the the municipality of Utrecht. Although interviewing online has some drawbacks, such as limited view of non-verbal communication, because of time limitations and the location of most of the interviewees interviews were held online. The exception is the interview with the respondent from the the municipality of Utrecht, because the respondent asked to be interviewed 'in real life'.

For the international case studies, already some research has been conducted. Some of the case studies have been terminated years ago, so interviewing is not feasible. Therefore, a desk research is chosen here. For each international case study, scientific studies as well as 'grey literature' (e.g. performance reports) have been used. For each case, the first search term was 'MaaS [city]' and from there, using the snowball technique², other studies or topics were searched.

3.2. Selection of the case studies

This research looks at five case studies, both Dutch and international. There are multiple MaaS pilot projects worldwide, but not all implement MaaS at the same degree, as found by, for example, the study of Kamargianni et al. (2016). This research only includes case studies with a full ICT integration of all available transport modes (MaaS level 3, according to Kamargianni et al. (2016)). Table 2 provides an overview of the case studies with some basic characteristics.

In 2017, the Dutch Ministry of Infrastructure and Water Management (I&W), together with seven regions, started developing MaaS pilot projects. In 2019, seven pilot projects were starting operations, two of which will be further examined here. The first pilot project which will be examined is from Utrecht. Utrecht is a fast growing city with an increasing strain on its road network (Rijkswaterstaat, n.d.). To decrease car ownership and car use, MaaS could potentially be a feasible solution. The pilot project of Utrecht is strongly focused on reducing car ownership (Goedopweg, n.d.). This matches the overall goal of MaaS, so the case of Utrecht is useful for further empirical research. However, this research also wants to examine MaaS in non-urban environments. Therefore, the MaaS pilot of the northern region of Assen-Groningen will be looked at. The cities of Assen and Groningen have a concentration of services, but in the surrounding region, the available public transport is limited (Rijkswaterstaat, n.d.). The addition of a pilot project more focused on rural areas is a useful addition to the other examined (international) case studies, which are much more focused on a city.

Aside from the two Dutch pilot projects, this research also looks at three international MaaS pilot projects. One of the international pilot project is Helsinki, Finland. The pilot in Helsinki is perceived to be the most advanced, which is the reason why this case study is included (Kamargianni et al., 2016). Gothenburg, Sweden is also a pilot project which has been studied by scientists and therefore provides another useful addition to the research. According to Karlsson (2020), the Gothenburg pilot is one of the few pilots which provides extensive information on the users and possible changes in travel behaviour. It is also worth mentioning that the Gothenburg pilot is one of the first MaaS pilot projects (Fluidtime, n.d.). However, the two Scandinavian case studies both have a relatively strong government position (Audouin & Finger, 2018; Audouin & Finger, 2019; Smith et al., 2018b). It is therefore deemed

² Using the reference list of one research article to find other relevant studies or topics.

necessary to also include a case study with a more market-oriented governance approach, to which Vienna, Austria is an example (Becker, 2022).

Table 2: Characteristics of MaaS pilot apps

Place	Name app	Transport modes available	Payment options
Assen-Groningen (The Netherlands)	Glimble	Public transport (buses, trains, metro, trams), taxi, shared bikes, scooters and cars.	Single journey ticket
Utrecht (The Netherlands)	Gaiyo	Public transport (buses, trains, metro, trams), shared bikes, scooters and cars. Parking options included.	Single journey ticket and parking tickets paid via in-app wallet
Gothenburg (Sweden)	UbiGo	Public transport, taxi, shared cars and bikes and rental car services	Monthly subscription
Helsinki (Finland)	Whim	Public transport (buses, trains, metro, trams), ferry, taxi, car rental, e-scooters, citybikes ³ and shared bikes.	Single journey ticket, seasonal ticket or subscription plan
Vienna (Austria)	SMILE	Public transport (buses, trains, metro, trams), taxi, shared bikes and cars	Monthly payment, according to use

Sources: Audouin & Finger (2019), Fluidtime (n.d.), Gaiyo (n.d.), Glimble (n.d.), & Whim (n.d.)

3.3. Respondents

Table 3 provides an overview of the respondents. The respondents are divided into three categories: government, transportation provider and app developer. These are derived from the actor model of Holmberg et al. (2016). The government relates to the ‘mobility manager’ of the model, the transportation provider to the ‘mobility service providers’ and ‘public transport’ actors, and the app developer relates to the ‘platform service provider’ of the model. The model also contains the ‘CMS operator’ and ‘CMS service provider’ actors, but these are perceived here as roles that can be fulfilled by either government or non-government actors and are not seen as an actor of their own.

³ During city bike season only (April 1st until October 31st)

Table 3: List of respondents:

Government	Mobility service provider	App developer
Ministry of Infrastructure and Water Management	Arriva [public transport]	Glimble (by Arriva)
Provincie Drenthe	Amber, Stapp.in [shared cars]	Gaiyo (by Innovactory)
Gemeente Utrecht		

In total, nine interviews have been conducted with the actors displayed in Table 3. A respondent from the the Ministerie of Infrastructuur en Waterstaat has been interviewed, because they are the initiator of the MaaS programme in the Netherlands (Rijkswaterstaat, n.d.). The Ministry has the overview over the seven MaaS pilot projects in the Netherlands and can therefore provide information that cannot be derived from interviewing only actors from the two examined case studies of Utrecht and Assen-Groningen. Respondents from the municipality of Utrecht and the province of Drenthe have been interviewed, since these government bodies have the responsibility over the MaaS pilot projects in Utrecht and Assen-Groningen respectively. The local/provincial government also write the proposition for a MaaS service provider. Respondents from these MaaS service providers of the Utrecht and Assen-Groningen also have been interviewed, as has been respondents from the app developers. Lastly, some respondents from mobility service providers have been interviewed. In this way, all relevant actors from the Holmberg et al. (2016) model have been interviewed. In this way, conclusions are based on all involved actors instead of just one group.

3.4. Data analysis

The interviews were recorded and transcribed, taking into account the anonymity and self-determination of the respondents (see paragraph 3.5). The transcripts were made using the computer program Amber Script, which saves time compared to manual transcription. The transcripts were, however, checked in detail to ensure that no errors are present. The transcripts were then analysed by coding. This means that the transcripts are read several times and classified on the basis of codes or themes that are linked to the question (Scheepers, Tobi & Boeije, 2016). The codes are derived from the interview questions, the transcripts themselves and also the background knowledge obtained from the literature section. To ensure that the codes are valid, the codes used are continuously reflected in the coding process and, if necessary, they are adapted to better match the subject of the highlighted text sections (Mason, 2018). The coding is done in the NVivo program. Coding with a computer program saves time and helps with analysis. The codes used can be found in Appendix 2.

When discussing the results, quotes from the respondents are used to substantiate the results. However, these are not literal quotes: they are paraphrased. For example, incorrect language has been omitted, as has stuttering or when things are repeated unnecessarily. When this is the case, the omitted part is replaced by three dots in parentheses: (...). Sometimes words are added to the quote to make it easier for the reader to understand. If this is the case, the addition is in square brackets: [addition]. The reason for choosing to paraphrase is to make the quote clearer for the reader. Colloquialism is often accompanied by unnecessary words (such as "uh") that distract from the core message. Nevertheless, the respondent's statement is always taken as literally as possible.

For the international case studies, this research conducts a document analysis of the most important and relevant (scientific) literature on the case studies, as has been stated before. The document analysis will follow the following structure: first, a brief description is given of the MaaS app, then the most important results are briefly presented. Next is an overview of the governance context and specifically the position and role of the government and regional Public Transport Agency. The analysis will conclude with a description of the relations between the governance context and the results of the MaaS programme.

3.5. Ethics

Ethics and integrity are important themes within the academic world. This research also aims to work in an ethically responsible manner, in particular with regard to empirical research. That is why the methods used are now being critically examined. Firstly, it is important that the research plan is well thought out. Scheepers et al. (2016) list six principles of scientific integrity. Transparency is one of them. This method chapter aims to be transparent by explaining and justifying all choices made. At the beginning of each interview, the interviewer shortly explained the topic of the research and purpose of the interview to be transparent to the respondent. Secondly, ethics comes into play with empirical research. The researcher is aware that the privacy and self-determination of the respondents takes precedence over obtaining data. This means that every respondent will be asked for informed consent. This means that all interviewees receive a brief but clear explanation of what the research entails, why they have been asked and whether they consent to their interview being recorded and used for the research. Transparency is also very important here, so, as stated before, respondents get a brief explanation of the goal and purpose before the interview starts and are also told how their personal data is handled. This informed consent is not requested just one moment, but applies before, during and after the interviews. As described earlier, the respondents will be informed about what the research is about before they are asked for permission to be interviewed. During the interview, the respondents can always ask questions and they have the right to stop immediately if they no longer wish to cooperate. After the interview, the respondent have the possibility to indicate that he/she does not wish the interview (or parts of it) to be used in the research. Immediately after the interview, the respondent also has the opportunity to say things without being recorded (and thus become part of the official interview). In addition, respondents can view the transcripts of the interviews on request. Some respondents have made use of this possibility. The respondents will never be traceable from this research: they remain completely anonymous and their personal data (including address and contact details) will be treated with strict confidentiality and will not be passed on to third parties. This also guarantees their privacy. The interviews are recorded to be used for the research. These recordings, and the transcripts, will not be shared with third parties.

4. International case studies

This chapter will look at the international MaaS pilot projects of Gothenburg, Helsinki and Vienna. With each pilot project, first the project will be described shortly. Next, the main results will be discussed, after which these will be connected to the governance situation concerning the MaaS pilot project.

4.1. Gothenburg

4.1.1. The MaaS pilot project

In 2013, one of the first MaaS pilot projects took place in Gothenburg, Sweden. Public transport, car sharing, bike sharing, rental car services and taxi were combined in one app: UbiGo. An account on the app was shared by members of a household, which paid for the MaaS services via a flexible monthly subscription (Fluidtime, n.d.). UbiGo featured ticket and payment integration, as well as the integration of a mobility package. Furthermore, UbiGo featured a journey planning and booking function (Kamargianni et al., 2016).

The pilot lasted for six months (from November 2013 till April 2014). In total, 195 participants in 83 households were paying customers. The minimal subscription fee was 1200 SEK per month (approximately €135,- in the time of the pilot). Households were recruited if they lived in neighbourhoods that were assessed to have sufficient accessibility to the services offered in the UbiGo app. It is important to note that only households that were considering selling their car, mentioning having reduced need for a car, or debating whether to by a car or not were given promotion material. During the trial period, 24/7 customer support was available, however, after the trial ended, it was not possible to continue the service, because the broker service ceased to exist (Strömberg, Rexfelt, Karlsson & Sochor, 2016).

4.1.2. Results of the pilot project

Overall, the MaaS pilot was deemed successful, with 93% of participants being satisfied with their travel and 97% wanting to continue using UbiGo. From the pilot, some 'matches' and 'mismatches' were derived by Sochor, Strömberg and Karlsson (2015). UbiGo became a platform for testing new offers, such as expanded public transport zones, which meant that participants had better alternatives and prices than they normally would. This encouraged participants to move away from private car use. Use of car rental or shared car services increased and private car use decreased, according to interviewed participants. Another 'match' was increased trip planning and better insight in and overview of the travel behaviour by participants.

The first category of mismatches pertains *behavioural changes*, for example car use. Car use was even lower than participants expected, so UbiGo found that participants purchased 30% more car hours than they used. Although this can be seen as something positive in a societal and environmental way, for UbiGo this means lower revenue, which is not beneficial for a profit-driven company perspective. When it comes to behavioural changes overall, 64% of participants said that they had experienced changes in travel behaviour during the pilot project. While this turned out positive (a majority stated to be more satisfied with their travel), this can create uncertainty for a MaaS provider as UbiGo, as well as transport service providers. The second category of mismatches relates to the *core structure* of UbiGo, an example being public transport. Public transport is heavily subsidized by taxes in Sweden. It is therefore difficult to make any profit on public transport for UbiGo, since it is the backbone of the UbiGo service. This situation, as well as other examples relating to the core structure of UbiGo, highlight that some outcomes might be positive for one actor, while these outcomes might be negative for another actor. Again, with public transport, the state subsidies are positive for the public transport operators, but negative for

UbiGo. This relates to the third category of mismatches, namely the *business model* of UbiGo. Firstly, the minimum prepaid subscription means less flexibility to participants than they expected beforehand. This model also potentially excludes the type of traveller with a low income, who only travels on occasion and thus has a below minimum travel demand. This traveller has to buy more services than he/she actually needs and therefore will likely avoid using UbiGo at all. Secondly, UbiGo works with volume purchases from the UbiGo service providers. On the one hand, this gives UbiGo greater negotiating power, but on the other hand this may not lead to the lowest prices for the customer. When this is the case, customers will likely buy these services from outside UbiGo, which means revenue loss. The fourth category of mismatches relates to the *back office* of UbiGo. Several (customer) services were deemed convenient for the customers and created added value for UbiGo, it also created more work for UbiGo and service providers. Integration and efficiency were suboptimal.

In summary, in order to improve, UbiGo needs to involve close cooperation between public and private actors and to consider the perspectives of users, the MaaS provider and mobility service providers, which sometimes are conflicting. Furthermore, the business model has some challenges that need to be deliberated (Sochor et al., 2015).

4.1.3. Governance and UbiGo

Analysis of Smith et al. (2018b) shows that the Public Transport Authority (PTA) had a strong role in the development of MaaS in West Sweden (under which the UbiGo pilot). One of the reasons behind the interest of the PTA in UbiGo and MaaS, is the overall goal of the public sector to increase the share of 'sustainable travel'. However, this caused some critique and resulted in some problems with the MaaS pilot: "*The PTA initially utilized a public procurement procedure to drive the development of MaaS. The analysis shows that both public and private actors perceived that this hindered experimentation, encumbering the transition from pilot to implementation and obstructing inter-organizational collaboration.*" (Smith et al., 2018b, p. 128). Some laws and regulations, made by regional level government (Pettersson & Frisk, 2016), make it difficult for the PTA to establish good coordination with private actors in relation to MaaS. The PTA also struggles to expand beyond their pre-assigned mission of providing regional public transport. Since the concept of MaaS was very new, the PTA found it difficult to establish inter-organisational trust. These factors make it a challenging task for the PTA to come to an agreement on business models and to assign responsibilities to actors in the emerging MaaS ecosystem (Smith et al., 2018b).

In summary, the governance situation concerning the MaaS pilot in Gothenburg can be described as following. The regional level government has an important role in transport planning and can set regulations (Pettersson & Frisk, 2016). From the literature, it does not become clear if the regional government has had a direct influence in the procurement processes of the Gothenburg MaaS pilot, or was otherwise actively involved. Therefore, the governance position of the regional government can be characterised as a *lawmaker*. In contrast, the PTA is strongly involved in the procurement procedure and the development of UbiGo. It also is concerned with coordination between private actors (Smith et al., 2018b). The governance position of the PTA can be characterised as a *convener*. As is described above, these two governance position are in conflict with each other: the PTA is constrained to successfully fulfil its role as a convener by the laws and regulations by the regional government. This results in a number of issues, such as lack of trust between involved actors and lack of agreement on business models. The strengths of the UbiGo pilot, on the other hand, cannot be directly assigned to any specific government position, nor to the involvement of the PTA.

4.2. Helsinki

4.2.1. The MaaS project

The Finnish MaaS project is regarded as the most advanced project and is one of the oldest large scale MaaS pilot projects (Kamargianni et al., 2016; Audouin & Finger, 2019). In 2016, the private start-up company Maas Global launched Whim: a MaaS app that offered planning, booking and payment services from different transport operators. Users of the Whim app can choose between four packages: one of which based on a 'pay per ride' concept, the other three being subscription packages. Since 2017, Whim is fully operational (Hirschhorn et al., 2019; Luukkainen, 2020). The MaaS project in Helsinki is *not* a pilot project. Rather, as Becker (2022) shows, it is developed as a lasting mobility concept with several data platforms and other mobility platforms being developed in the last couple of years. However, this research will only focus on Whim.

4.2.2. Results of the project

The most recent results of Whim were published in 2019 and cover the first full year of operation of Whim. In late 2018, the Whim app had 70000 users, which is almost 10% of the entire population of Helsinki. The percentage of trips using public transport was significantly higher under Whim users (63%) than non-Whim users (48%). It is noteworthy however that the number of trips using public transport does not deviate significantly between Whim users and non-Whim users. Relating to public transport, Whim users often use other modalities in combination with public transport to solve the 'last mile' problem. For example: 30% of bike trips were taken within 90 minutes after using public transport. The early adopters of Whim show a high preference for multimodal transportation. The areas with the most Whim users are found to be the areas with the highest accessibility by bicycle. At the time of the report, other means of transportation (e.g. shared car) were just introduced, so the report has no data on these modes. The authors suggest however, that, based on the popularity of Whim in relation to accessibility by bicycle, MaaS usage will increase further when other means of transport are added (Hartikainen et al., 2019).

The authors conclude by stating: "As it is often case with mobility, many of the findings in the travel behaviour are directly linked to land-use and existing public transportation network. As the backbone of MaaS ecosystem – at least in Helsinki's case – is the public transportation, it is natural that the big part of user segment comes from the areas close to high accessibility to public transportation" (Hartikainen et al., 2019, p. 49).

4.2.3. Governance and Whim

National government

Since 2009, the Finnish Ministry of Transport and Communications has been working on advancing Information Technology Services (ITS). In that same year, the ministry released the first National ITS Strategy aimed at promoting the use of ITS to reduce car use and promote sustainable transportation modes. In 2013, the second National ITS Strategy was released that insisted on the development of seamless door-to-door, ICT facilitated, trip chains with the flexibility and functionality like a car, but without the costs and responsibilities like car ownership. In this way, even before the concept of MaaS existed, the Finnish government already paved the way for MaaS. The biggest contribution to the development of MaaS came in spring 2017 in the form of the Finnish Transport Act (Audouin & Finger, 2018; Audouin & Finger, 2019). The central aim of this act was to promote digitalisation of transport services and more efficient use of data, to create a more favourable operating environment for new digital services and business models. The act was implemented in three stages concerning the sharing

of data between mobility service providers (stage 1); organising all transport and traffic registers and data under one legislation (stage 2); and involving subsidiary issues and emergency plans for logistic companies in case of major events (stage 3) (Hirschhorn et al., 2019).

It is clear then that the national government in Finland has been heavily involved in MaaS development and diffusion, while focusing on enabling private entrepreneurship. The government funded research and development and organised formal and informal collaborative networks (Smith et al., 2018a). In the earlier stages of MaaS development (and the years before the concept of MaaS existed), the national government can be characterised as an *experimenter*. Besides Whim, other data platforms and mobility platforms were being developed (Becker, 2022). After a couple of years the approach of the government towards MaaS, and Whim in particular, changed from an experimenter approach to a *lawmaker* approach. This can be seen mainly in the Finnish Transport Act, where the rules of engagement between actors within public transit have been changed to create a more favourable operating environment for MaaS providers, such as Whim (Hirschhorn et al., 2019).

Regional Public Transport Agency

Contrary to the national government, the regional PTA has, in first instance, not been welcoming to the new MaaS developments in Helsinki. According to Smith et al. (2018a), the PTA has been more focused on improving the current public transportation ecosystem of Helsinki and fulfilling incremental growth goals. What is also worth mentioning is that the PTA has not been involved in plans for the development and diffusion of MaaS. This led to a lack of enthusiasm in the PTA to cooperate with Whim, when it launched. In 2016 it was only possible to purchase single tickets via Whim, which meant that Whim was not able to build a financially stable business model. Under mounting pressure from the national government, the PTA took actions to be more involved with MaaS. The most important of these actions is the creation of OpenMaaS, where seasonal tickets of all third parties (mobility service operators) were made available (Hirschhorn et al., 2019; Audouin & Finger, 2019).

According to Hirschhorn et al. (2019), the actions taken by the PTA since 2018 and the direct involvement of the PTA in MaaS development, characterise the PTA as a *provider*. The PTA adjusts itself in a changing environment with the aim of having (or keeping) the leadership position in the public transportation ecosystem (Smith et al., 2018a; Hirschhorn et al., 2019). Therefore, even though the PTA can be classified as a provider, without pressure from the national government, mainly through the Finnish Transport Act, it is unlikely that the PTA would have been involved in MaaS in the same degree.

4.3. Vienna

4.3.1. The MaaS pilot project

From 2009 onwards, the Austrian national rail operator ÖBB and the municipal transport provider of Vienna (Wiener Stadtwerke) started cooperating with the development of the Graphic Integration Platform (GIP). This platform contains current data on traffic infrastructure of multiple transportation modes. With the uniformity of the data, GIP laid the groundwork for the development of MaaS in Vienna. In 2012, research started on developing a MaaS pilot in Vienna, which became operational in 2014 with the SMILE app (Becker, 2022). The SMILE project aimed to test a prototype of the planning, booking and payment of multimodal trips. SMILE offered several transportation services with a monthly payment according to use. Lastly, the pilot project lasted six months (Karlsson, 2018; Durand, Harms, Hoogendoorn-Lanser, & Zijlstra, 2018).

In total, around 1200 users were registered of the SMILE app. After the pilot project was terminated, a survey was sent to the users of SMILE. This research was conducted by SMILE itself, however no

independent other research is available. Before the most important results are presented, it must be considered that only 170 users responded to the survey. The respondents can be classified as representative for 'early adopters', with the respondents being mainly well-educated and with a high income. Most respondents were men and were between 20 and 40 years old. This means that the respondents are not representative of the average traveller of Vienna and possibly from the average SMILE user (Karlsson, 2018; Durand et al., 2018).

4.3.2. Results of the pilot project

6% of the respondents used the SMILE service daily, with 30% using the app several times per week. When looking at the kind of journey, the results show that the majority of respondents used the app for private purposes or leisure activities. Using the app resulted in changes in travel behaviour, under which combining multiple transport modes more often. A minority of users reported to use public transport more often and another group reduced the use of their car (Karlsson, 2018). The inclusion of the private transportation modes of SMILE users was considered as positive by the respondents. The high level of integration was also seen as a benefit (Durand et al., 2018).

4.3.3. Governance and SMILE

As has been stated earlier, the SMILE project is the result of a collaboration between ÖBB and Wiener Stadtwerke. The Austrian Ministry of Transport and Innovation helped the creation of MaaS in Austria by developing the Intelligent Transport System action plan in 2011. This action plan aimed at providing travellers with information on transport as well as booking and payment services. However, the public and local government was not involved in the development of SMILE or other MaaS apps (Pinto, 2021). Therefore, the position of the government best fits the *lawmaker* approach, but this is not a perfect fit. In short, a lawmaker enables niches by using regulation as the instrument to (re)design the institutional setup of the mobility system in order to allow market forces to drive innovation. A lawmaker governance approach is seen as an active, hands-on approach (Hirschhorn et al., 2019). In the case of SMILE, the government did help market forces to develop MaaS by the Intelligent Transport System action plan. However, there is a lack of evidence to support the claim that the government was actively involved in the development of SMILE. The development of SMILE was left to the market.

At the end of 2014, the SMILE app terminated. The two main reasons for this were the end of public funding and the growing divergencies between ÖBB and Wiener Stadtwerke. In fact, after the end of SMILE, both parties went on to develop their own MaaS apps: ÖBB co-developed, with an Austrian venture fund, the app iMobility, while Wiener Stadtwerke founded a start-up subsidiary which released the WienMobil app in 2017. Both apps are currently active, but have limited collaboration with each other (Audouin & Finger, 2019). Pinto (2021) argues that the reason of the terminated collaboration between ÖBB and Wiener Stadtwerke lies in the position of the government. The lack of guidance and a concrete vision from both the Austrian Ministry of Transport and the municipality of Vienna on how to stimulate collaboration could clarify the reason for the divergence, according to the author.

4.4. Conclusions

The main findings of the analysis are summarised in Table 4. In conclusion, the three examined international case studies show that different governance approaches between public actors lead to some struggles. In the case of Gothenburg, the difference in governance positions between the government and the PTA led to friction between the two parties. The PTA is constrained to successfully fulfil its role as a convener by the laws and regulations by the regional government, which results in a number of issues. In the case of Helsinki, the national government was more progressive on developing MaaS than the regional PTA. In fact, the national government had to force the PTA to collaborate with

Whim. Lastly, the case of Vienna shows that an absence of hands-on government intervention does not necessarily lead to a worse outcome, even though the two main driving forces (ÖBB and Wiener Stadtwerke) behind the MaaS pilot project did separate their ways after the conclusion of the pilot.

It is not possible to measure the success of each MaaS pilot. The number of users of the examined MaaS apps was quite limited, except for Whim which was already operational for some time when the research was conducted. All examined cases, however, show positive results when looking at change in travel behaviour and use of transport modes alternative to the private car. Thus, using the MLP, the issues at the regime level do not seem to translate to the niche level.

Table 4: Main findings from the international case studies

	Gothenburg	Helsinki	Vienna
Duration	November 2013 – April 2014	Operational since 2017	Spring 2014 – Autumn 2014
Number of users	192 users	70000 users (in 2018)	1200 users
Main results	<ul style="list-style-type: none"> • Reduced car use • Monitoring of travel behaviour • Unexpected behavioural changes • Public transport forms an obstacle • Revenue loss due to inflexible payment options • Poor integration and efficiency 	<ul style="list-style-type: none"> • Relatively high use of public transport • Use of other transport modes in combination with public transport • Use of MaaS higher in areas with good access to public transport 	<ul style="list-style-type: none"> • Limited daily use • Use for private or leisure purposes • Use of combination of transport modes • Reduced car use (by a minority) • High level of integration
Governance approach	Regional government: lawmaker PTA: convener	National government: from experimenter to lawmaker PTA: provider (under pressure)	Government: lawmaker, though not actively involved in the pilot

5. Dutch case studies

This chapter will look at the Dutch MaaS pilot projects of Assen and Groningen⁴, and Utrecht. With each pilot project, first the project will be introduced shortly, after which the opinion of the interviewees on the pilot project will be discussed. Next, the opinion of the respondents about the government position will be highlighted. Finally, the governance approach will be analysed. This chapter will conclude with a comprehensive summary.

5.1. Case study Assen and Groningen

5.1.1. Introduction of the pilot

General development of MaaS in the Netherlands

In 2017, the Dutch Ministry of Infrastructure and Water Management (I&W), together with seven regions, started developing MaaS pilot projects. In 2019, seven pilot projects were starting operations. The general goals of the pilot projects were:

- Linking of travel information and offering of very user friendly apps to let the traveller choose between all transport modes and offer planning, booking and payment services;
- Getting experience and knowledge from MaaS and learning from this experience, with a good application and sufficient users as requirements;
- To make the first step, with MaaS, to a sustainable future of travel, where ownership is less and service more important (Rijkswaterstaat, n.d.).

According to the respondent from the the Ministry of I&W, in 2017, expectations around MaaS were rising, but there was a lack of both knowledge and experience:

“[I]n 2017, we were in a situation where there was a lot of talk about Mobility-as-a-Service by a lot of different parties (...). So several expectations were rising about what Mobility-as-a-Service could be and could mean. Really, nobody knew, so the idea was: (...) let’s try it out in a number of pilots and then [we] will know eventually what’s going good, what’s not going well and where are the obstructions.” (respondent from the Ministry of I&W)

The Ministry of I&W started consultations with several private parties (‘marktpartijen’) to explore the needs of the market. Then, the Ministry wrote a proposition (‘raamovereenkomst’) where parties could apply to, to include all parties interested in MaaS under the same conditions.

“The idea has always been: (...) you can choose to develop one MaaS app with one party [but], we chose emphatically to let multiple parties work on it. Those parties focus on specific target groups, so we have a number of [apps].” (respondent from the Ministry of I&W)

Furthermore, as the above quote states, the Ministry of I&W deliberately chose to develop multiple MaaS apps to focus on multiple different target groups, in order to get as much experience possible and to learn from the different pilot projects.

Description of the project in Assen and Groningen

One of the pilot projects is called ‘Groningen-Drenthe’ and involves the cities of Assen and Groningen and the surrounding area in the provinces of Groningen and Drenthe. According to the respondent from

⁴ The interview with the Ministry of I&W is included in the paragraph about the Assen-Groningen MaaS pilot. Although the Ministry of I&W stands above all pilot projects, this choice was made for clarity reasons.

the the province of Drenthe, the goal of the pilot project is to unlock all available transport in Groningen and Drenthe to all users. The pilot also focuses on so-called 'Wmo' transport. In short, Wmo transport consists of special taxis or minibuses which are not available to the general public. Wmo transport is meant for people with reduced mobility, psychosocial problems or people who are unable to use regular public transport in another way (CROW, n.d.).

The main reason the province of Drenthe (together with the province of Groningen) decided to join the national MaaS programme of the Ministry of I&W is that they wanted to integrate public transport (for which they are responsible already) into Wmo transport. This, combined with reduced availability of public transport in the rural parts of the provinces, led to the provinces seeing the potential in introducing MaaS:

"Not every village [is served by] a bus, so you can book the so-called hubtaxi to travel to the hub [for public transport]. Although this is really nice, people should be able to find it, and especially the digital access is something that didn't exist before." (respondent from the Province of Drenthe)

The proposition for the MaaS pilot in Assen-Groningen was won by Arriva, a public transport provider already active in the area. The reason for Arriva to join, according to the interviewed employees, was twofold in nature. On the one hand, the decision to apply to the MaaS proposition was made from a strategic perspective, as explained by one of the interviewed employees:

"[T]he MaaS pilot Groningen-Drenthe is important for Arriva, (...) because it's partly geographically located in an area where we are the public transport provider. Then it is of course very interesting to look if you can take the position of MaaS provider, instead of only being an executive provider, which has to play somebody else's game. We preferred to decide the game ourselves." (Arriva, employee 3)

The other aspect of the reason to join the MaaS pilot was that Arriva, as a public transport provider, has the mission to deliver public transport to everyone. The additional target group of the Assen-Groningen MaaS pilot is Wmo transport and Arriva was already focused on this target group.

5.1.2. Perceived issues

The opinions of the interviewees on how well the pilot project performed were mixed. Both the respondents of the Ministry of I&W and the province of Drenthe were unsatisfied with the number of users. Both respondents mentioned that the COVID-19 pandemic probably was the main reason for this, since travel was discouraged during most of 2020 and 2021. The interviewee from the province of Drenthe told that evaluating the pilot project is not something static:

"We formulated [the goal] broadly in the sense of all transport [modes] being connected. There will always be forms of transport that are new or that are not included in [the app] for whatever reason. So I would almost say: it is never finished, there is always something to develop. The same applies to 'it is suitable for everyone'." (respondent from the Province of Drenthe)

The interviewee of the province is content with the achieved results, even though they realise that the pilot project is not perfect, as there are still areas that need attention and development. The three interviewed employees from Arriva all said that on a basic level, the MaaS app was functioning, but that there were some 'confounding factors'. The goal of Arriva to integrate Wmo transport in the MaaS app was not achieved:

"Specifically for the Wmo part, we are still in technical development. What we have learned with each other is that in practice, things work out differently than you would think beforehand on paper. (...) if you want to

include Wmo transport in a MaaS app, then you are really dependent on the willingness but also the technical possibilities (...) from the actual physical operators of Wmo transport to get it working in a MaaS app in the end.” (Arriva, employee 3)

Another employee was more negative about the project, and the concept of MaaS in general:

“The app is not a magical solution. There is a difference between practice and theory. (...) The MaaS apps in the Netherlands look too much alike.” (Arriva, employee 2)

The problem with this, according to the employee, is that they work as direct competitors to each other. Since the number of users is so small, this hurts the development of MaaS. However, the respondent from the the Ministry of I&W was positive about the overall results. According to the interviewee, the Ministry encountered some barriers, some of them have been overcome, others still require action. This action must come both from the government as from MaaS service providers, according to the respondent. The interviewee emphasised that the Ministry of I&W ‘certainly learned’ from the MaaS programme. It thus becomes clear that even though the MaaS programme does not go without obstacles, there is some difference in the barriers regarded by the involved actors. For example, one of the reasons that the interviewee from the Ministry of I&W did not mention low number of users as a problem specifically and the interviewees from Arriva did is because Arriva is a market actor and the government obviously not. It is important to further zoom in on some of these barriers and perceived issues.

Finance

In the current situation, the provincial government subsidises market parties to join in on the MaaS pilot. The interviewee from the province of Drenthe explained that the province gives subsidies but also offers support in order to jointly achieve the goal of developing MaaS. From the side of the province, this requires ‘a lot of effort’, but according to the interviewee, the amount of financial support from the government is not enough to develop a MaaS app and put it in the market, so for the majority, market parties have to cover the costs themselves. According to the respondent, however, if the province would not have given subsidies it is unlikely that commercial parties would have joined the MaaS pilot. This is also confirmed by an employee of Arriva:

“I say this from my personal opinion, but I think there is no pilot which can succeed merely within the [scope of] the pilot to deliver a viable business case within two years, because the development in the Netherlands is not that far yet.” (Arriva, employee 3)

The interviewee stated that the development of MaaS is not well known in the Netherlands, so the need for a MaaS app is not sufficient. For market parties to have a financially sound business case, the concept of MaaS needs to be more familiar under travellers, which takes time. The respondent did not say anything about the possibility of a viable business case in the future, but the respondent from the the province of Drenthe stated that he thought that in time commercial parties will be able to form a financially stable business model.

Added value of MaaS

The low number of users and lack of public awareness about MaaS have their consequences on the attractiveness of the concept for commercial parties. Employee 1 from Arriva stated that the combination of these ‘disturbing factors’ leads to the providers of various transport modes questioning the added value of MaaS.

Another aspect of this theme is the added value of MaaS for users. The interviewee from the province of Drenthe was convinced of the added value of MaaS in general, but stated that the public may not:

“Look, the added value is that you can plan, book and pay a door-to-door chain trip, separate from the providers. (...) It’s not that when MaaS didn’t exist, people didn’t travel from A to B, so you have to ask yourself to which extent you provide a convenience and added value, or that [it] is just an impediment. I think most of the journeys that people make, they make them regardless, they really don’t need a MaaS app for that.” (respondent from the Province of Drenthe)

The respondent also mentioned the high convenience of the current public transport network and the OV-chipcard of the Dutch Railways (NS). In short, with this card you pay as you go on all public transport in the Netherlands and with the option of renting bikes from NS. The respondent also said that a regionally focussed MaaS app, like Glimble in Assen and Groningen, is less valuable than a nation-wide app, because users tend to travel outside of the region occasionally. This focus on a region was mentioned as one of the strengths of MaaS, however, by an employee from Arriva. The employee mentioned three points of added value of the concept of MaaS, one of which being the region-scale:

“The distinctiveness [of MaaS] lies in the inclusion of [mobility service] providers, in particular nationally and regionally. [I]f you compare this with Google, they only look to the big players, to the big providers, but that does not offer the intricacy of the Netherlands and (...) Groningen-Drenthe. As MaaS provider, I think you can distinguish yourself by putting effort in connecting the regional mobility service providers, what big parties as Google perhaps neglect.” (Arriva, employee 3)

The employee is referring to Google Maps, where it is also possible to get an overview of a planned journey with multiple transport options. However, according to the respondent, because of Google being a worldwide organisation, small mobility service providers may not be noticed by Google. Therefore, a regional MaaS provider can deliver a better service to customers:

“Offers in terms of cost, in terms of ‘we know you, we can give you tailor-made advice’, on the basis of data targeted offers. [O]ffers that correlate with the place where you work, with your employer; where you study, with your educational institution; where you go with an event, where you buy your combi ticket. So really making propositions tailor-made for you, on the basis of who you are, how you travel and what you need.” (Arriva, employee 3)

This paints a picture where the MaaS provider has access to a lot of data from the users so the provider can show exclusive travel options in the app to the users. The respondent assumed that Google would not be willing to get this data and to make these exclusive offers. Although it is not possible to say for certain what will happen in the future regarding big tech companies like Google and MaaS, the topic of added value is definitely not only linked to the user of MaaS, but also to other (potential) competitors. One of the basic requirements for a MaaS app to have added value, regardless of the relation with other market parties, is to be a good working product. According to Arriva employee 3, the basis for a MaaS app is to be a user-friendly, good working technical product. The user must be able to enter their plan, book and pay seamlessly. If this is not the case, ‘you’re out’. This basic requirement links to the next issue, that of technical integration.

Interoperability

A good working MaaS app with a good API requires good interoperability. Therefore, in the Netherlands, a national API has been created to connect the different mobility service providers with the MaaS provider. According to the respondent from the the Ministry of I&W, the Ministry made the initiative and, together with a number of market parties, developed a national API. This national API (so called TompAPI) should make it easier for mobility service providers to join a MaaS app, but some respondents were critical about this. According to Arriva employees 1 and 2, this TompAPI has many versions, which lead to a lot of time being spent at making the technical connection between a mobility service provider and a MaaS app. Because of all these different versions, creating a uniform technical standard is difficult. Furthermore, these employees were unsatisfied with the integration of public transport in MaaS. Especially the exclusion of discount tickets or subscriptions from NS in the Glimble app were mentioned. This problem was acknowledged by the respondent from the the Ministry, even though the interviewee had a different opinion on NS:

“So what we did is taking the initiative to introduce what we call ‘MaaS-worthiness requirements’. These are included in public transport propositions and state (...) that the MaaS providers get access to tickets from public transport operators (...). In the case of NS it’s organised pretty well (...) but there are some mobility service operators that only offer hourly tickets. (...) [This] is of course not competitive so the MaaS service providers find this insufficient.” (respondent from the Ministry of I&W)

This highlights that interoperability and integration of data also relates to relations between the different actors.

Collaboration

As has been stated earlier, one of the goals of the MaaS pilot was to learn from the experience. The interviewee from the province of Drenthe told that in the case of the MaaS pilot Groningen-Drenthe, the province and Arriva had some differences but that the collaboration in the pilot project was fruitful. The collaboration was something quite unique and innovative, but also an informative experience. About the relation with other actors, the respondent stated:

“[The] mobility service operators are all commercial parties. Some carry out a proposition, but shared mobility providers (...) offer plainly their scooters or cars or whatever (...). [In the end] you all want to carry it out, so there is some kind of dynamics.” (respondent from the Province of Drenthe)

There are multiple parties involved, each with their own goals and ways of operating. Public transport operators have to fulfil a proposition from the government. Private mobility providers do not have to do that and operate with the goal of gaining a bigger market share. Even though these goals and ways of operating differ, in the end all parties contribute to the development of MaaS. One of the employees from Arriva was also positive about the collaboration between them and the province of Drenthe:

“We have a common interest to make a success out of this and we complement each other from what we contribute to the collaboration. So I would want to formulate it as a real partnership.” (Arriva, employee 3)

Another employee was less positive about the collaboration with private parties:

“There is less cooperation with market parties. We see some cooperation though between taxis and Wmo transport. (...) The public transport sector must still make the connection with MaaS.” (Arriva, employee 1)

This interviewee was convinced that public transport and shared mobility have fundamentally different roles, which makes cooperation more difficult. However, if this collaboration would succeed, the combination of public transport and shared mobility would make for a better offer of MaaS.

5.1.3. Government position

All respondents were asked what role they saw fit for the government in the future of MaaS. To start, the Ministry of I&W had an active role in starting MaaS in the Netherlands, but according to the interviewee, that role is currently being debated:

“If I can say it myself, I think we are less going to regulate and more going to facilitate. This means that you let those companies build their business themselves, and that's up to them, to discover the market, to make campaigns, to present a good offer to travellers. As government, you should make sure that if there are threats or opportunities, that you take an active role.” (respondent from the Ministry of I&W)

For the municipalities, this means to stimulate shared mobility services, for example by reducing parking norms. For the national government this can mean making laws and regulations, however:

“[T]hen we're not the director of all actions and of a detailed programme, but we're more facilitating, keeping in contact with MaaS service providers. We only provide the right preconditions if there is a need for them.” (respondent from the Ministry of I&W)

The respondent stated that the national government does not want to develop a MaaS app themselves, nor direct which one of the current seven apps will be chosen to be the national app. The government only wants to provide a framework in which the market can operate and to take action in the case of a 'winner takes all' scenario in which one party has a monopoly on the market. The interviewee mentioned as an example that the government would interfere if Google would conquer the shared mobility sector.

The respondent from the the province of Drenthe stated that the provincial government should confine themselves again to their original role of being responsible for public transport. The respondent stated that the province should be focussed on the goal of providing sustainable mobility modes and that MaaS can be used as a means for achieving that goal. In essence, the quite actively involved role that the province currently has, should change to being less directly involved. All the respondents from Arriva also thought that the role of the government in MaaS should be limited. The role of the government should be focussed on creating a framework for market parties to operate in.

“I strongly believe that in the end the market should do the work, because the market determines: these are the needs, these are the solutions that are viable, that are necessary to meet the needs. (...) What I do see very clearly as a role for the government in this is facilitating a level playing field.” (Arriva, employee 3)

According to the interviewee, when in the future there is a need for experimenting on another thing within the mobility sector, the government could take on a more hands-on position again. This is similar to what role the government has taken in the development of MaaS, which leads to the analysing of the governance approach.

5.1.4. Governance approach

As previously stated quotes show, the national and provincial government are both involved in the development of MaaS. In order to define the governance approach, these interactions will be further examined here.

Ministry of I&W

The Ministry of I&W was de initiator of the seven MaaS pilots in the Netherlands. Their reasoning for this was, according to the respondent, to dampen the negative consequences that may arise from MaaS:

“You can say: ‘leave it to the market and we’ll see what happens’ and let a thousand flowers bloom. That has been the criticism sometimes. (...) [But] an Uber or an AirBnB, or that kind of platforms that are developed... they have big advantages, but there also a lot of disadvantages that can be mentioned, and you often see that governments have to react in quite a late phase, and often you’re too late and the damage is already done.” (respondent from the Ministry of I&W)

The respondent stated that market parties need the preconditions from the government to successfully develop MaaS. One of these preconditions were the earlier mentioned ‘MaaS-worthiness requirements’ (MaaS-waardigheidseisen). The government then organised multiple market consultation sessions to assess the market needs. Next, as stated in the introduction, the national government chose to develop multiple MaaS apps instead of one national app. These apps would, however, be available nation-wide despite their regional focus.

The Ministry of I&W would offer some financial support to market parties which joined the MaaS programme. The goal was that those companies would later be able to form a financially sound business case but would need some financial support to start. Another point of action from the Ministry was the creation of the aforementioned TompAPI, together with market parties, to provide a technical standard. The Ministry worked together with some municipalities and provinces that were acting as contracting authorities that tendered the apps to other parties. In the case of Groningen-Drenthe, the transport operator Arriva won the tender and developed the app Glimble. The Ministry is still closely tied to the development of MaaS:

“We are closely involved. I myself am a member of the environment team of the programme, we have environment managers who have almost daily contact with the project managers. (...) We also have contact on a regular basis with all MaaS service providers which carry out a pilot, one on one, but also in a joint consultation. The programme board consists of the [national] government, the regional government, so a municipality or province, (...) and the MaaS service provider and those programme board [meetings] take place on a monthly basis.” (respondent from the Ministry of I&W)

The governance approach that best fits the Ministry of I&W then is the *experimenter* approach. The Ministry of I&W took the initiative to develop and diffuse MaaS in the Netherlands. The Ministry set up preconditions that private parties had to comply with. Even though these preconditions leave room for the market to act in, some detailed guidelines are also included, such as the requirement of public transport operators to include all available ticket types. After the start-up of the programme, the Ministry put the development of the MaaS apps in the hands of municipalities and provinces. The Ministry is still involved with MaaS, but to a lesser extent and from the perspective of learning, which best fits the experimenter approach.

Province of Drenthe

The role of the provincial government is less extensive than that of the national government:

“If you look at our role in a general sense (...) it is limited to affairs concerning the preconditions. So in this case it involves in particular our responsibility from the public transport proposition and for municipalities regulating shared mobility by a licensing system.” (respondent from the Province of Drenthe)

The province is also delivering (financial) support to commercial parties in order to achieve the desired goal of developing MaaS. According to the respondent, this takes a lot of effort from the province, but they realise that this is just a part of the total cost of setting up a MaaS app. One employee from Arriva summarised the role of the province as follows:

“The province offers not only subsidies, but also the regional position, the platform, the network, the boosting function. We offer the substantive expertise, the technical solutions and things like that. We have a common interest to make a success out of this and we complement each other from what we contribute to the collaboration. So I would want to formulate it as a real partnership.” (Arriva, employee 3)

Based on this statement, the appropriate position of the province of Drenthe is that of a *convener*. The province helps private actors by providing a network and financial support. The relation with the MaaS provider (Arriva) is characterised as a partnership instead of a top-down relationship. However, the province is also reliant on actions from the market, instead of organising its own.

5.2. Case study of Utrecht

5.2.1. Introduction of the pilot

Another of the seven pilot projects involves the municipality of Utrecht. According to the respondent from the municipality of Utrecht, the goal of the pilot project is to offer easier, faster alternatives to car travel with MaaS. This is done via including all alternative transport modes in one app with which users can plan, book and pay. Specifically for Utrecht, the municipality wanted to have 3000 ‘valuable users’ at the end of the pilot in 2022. A more general goal of the municipality is that:

“The pilot should give shape to: to what extent are residents (...) tended to sustainably use a MaaS service? Which conditions do we have to fulfill, as government? (...) Basically it’s really all about behavioural change: what services do you need and which role can MaaS fulfil to accelerate the adoption of alternative transport modes?” (respondent from the Municipality of Utrecht)

The proposition for the MaaS pilot in Utrecht was won by Innovactory. According to the respondent, one of the reasons for Innovactory to join was to earn money in operating in a niche market. Another reason was to contribute to the transition to sustainable mobility. Innovactory focussed on car users in the MaaS programme, because:

“Around 80 percent of travels in Western Europe is made by car. So if you want to have impact and at the same time help people that currently [have] a car to change their behaviour, you have to focus on the driver.” (respondent from Innovactory)

One of the key principles in the development of the app Gaiyo was that the users want to have a choice which transportation mode best fits their needs:

“People really don’t tell much about what they want to do with a journey. To well arrange Mobility-as-a-Service you have to know everything: do you travel on your own, do you travel to a job interview and do you want to be ten minutes early, do you have luggage? (...) I believe that nobody tells that to an app. It’s in your head, you make that decision yourself. You think by yourself: ‘I think I need a cargo bike’. A system is not

going to determine that for you. This means that you have to help people to get that information, instead of that you advise them what they might need. (...) You should not start with [developing] a journey planner but [with asking]: ‘which [travel modes] are located in your environment’, so that you can make the best choice yourself, based on where you are.” (Innovactory)

The other two interviewed mobility service providers Amber and Vecore also focus on the car. The respondent from the Vecore told that the reason for joining the MaaS project in Utrecht was that the company was looking for a business model that was focused on the future and that better connected with the current trends and developments. Besides making a financially stable business model, Vecore also wanted to contribute to a sustainable future within mobility.

“While I was busy with these themes, I was approached by the Ministry of I&W, I knew [person] as well as some others. (...) I joined in these first settings in The Hague together with thirty market parties, service providers, where it all was kick-started.” (respondent from Vecore)

The interviewee from Amber stated that when the company heard of the MaaS initiatives, they were excited to join. At the one hand, this was because the company was quite new and was looking to have a sustainable business model with a good product-market fit. Because Amber is focused on providing shared vehicles targeted at the business market, they operate in a very niche market. According to the interviewee from Amber:

“What we had observed then is that in many respects the offer was lacking, of Amber or of shared mobility in general, to seriously take a stand against the private car.” (respondent from Amber)

The respondent told that Amber thought about their network, where to offer their services, both on the scale of in how many cities and in which areas of cities the company wanted to operate. The other reason the interviewee gave of why Amber decided to join was their focus on the car being included in the MaaS programme:

“Shouldn’t we have a model in which you are the hamburger bun? We are the hamburger, so to speak, and everything like bicycle or public transport: you need it, it completes the hamburger sandwich; it’s not the best, because the car is really tasty, but you need it. (...) If you can offer multiple modalities in one platform, then it has added value for the end user.” (respondent from Amber)

In this quote, the respondent proposed an analogy for a MaaS platform and when it has added value for the user. This leads to the topic of added value, but first the general results will be examined.

5.2.2. Perceived issues

Overall, all interviewed respondents were found to be disappointed in the course of the Utrecht MaaS pilot. The expectations were higher than the outcomes. The goal of 3000 users is not achieved, which is largely attributed to COVID-19 restrictions on travel. According to the interviewee from the municipality of Utrecht, the Ministry of I&W intended to set up a digital learning environment so that all actors could learn from other Dutch MaaS projects and the experiences of one another.

“You must have heard something about the learning environment? Well, the [project] slowed down and eventually was cancelled. In my opinion, this has been a major setback for the programme. We are going to look for what learning we regionally can collect by making agreements with MaaS service providers. It’s really sad that this happened.” (respondent from the Municipality of Utrecht)

The interviewee from Innovactory also remarked that the corona pandemic was a major setback to the development of MaaS and the diffusion of their app Gaiyo. But, according to the interviewee, the pandemic also offered opportunities:

“Is [the pandemic] really bad? Yes, we would have liked to start quicker and bigger, also with marketing. [But] if you look at the time it has given us to further develop the app and the service, it’s not that bad. Because of [the extra time], the service has improved. With a smaller user group (...) you can make mistakes more easily, let me put it that way.” (respondent from Innovactory)

What the respondent means by stating ‘with a smaller user group, you can make mistakes more easily’ is that with a small user group in a new app, the users tend to expect more mistakes and bugs. This gives the developer room to try out features and to fix mistakes without losing a big group of unsatisfied users. That is why the COVID-19 related travel restrictions have helped the development of Gaiyo, according to the interviewee. On the other hand, while the COVID-19 pandemic can be seen as a major overarching barrier to the development of MaaS in the Netherlands, the Utrecht MaaS pilot included, this does not take away that there are some specific issues that need to be discussed.

Business model

As is being stated before, the number of users of Gaiyo is much lower than expected. The respondent from the Amber stated that one of the reasons for Amber to join the MaaS programme is to create a better business case. However, this turned out to cause a financial burden on the company. The respondent told that the company have put a lot of time, energy and resources into the MaaS programme, but that they notice that MaaS does not ‘gain much momentum’. The interviewee showed his doubts about the continuation with the MaaS programme:

“At a certain moment we were [thinking] like: okay, we have put in half a year of development and we have a fulltime account manager for this [purpose]. (...) If you still don’t succeed as MaaS providers to deliver clientele and we can do that through our own channels, well, at one point we have to make a decision: are we still going to put in a lot of time?” (Amber)

These statements show an imbalance between the effort, time and capital that Amber has to put in on the one hand and what the benefits are to the company from joining the MaaS pilot on the other hand. Even though the respondent was happy about the technical and qualitative support they got from Innovactory (the Utrecht MaaS provider), the value of MaaS for Amber is lower than they had hoped, according to the interviewee.

Added value of MaaS

Besides the value of MaaS for mobility service providers, the added value of MaaS for users was also mentioned in the interviews. As with the case of Assen-Groningen, some respondents from the case of Utrecht also mentioned that MaaS’ added value above that of Google was the potential tailored offer. In order to achieve this, a lot of technical integrations must be made with local mobility service providers, or other clients like a big employer organisation:

“The question (...) becomes: which party can serve a niche [in the market] with a service around it, which is valuable for you as a user? I can imagine why for example for big employers, that you can build specific propositions of which Google Maps says ‘that is too much customisation’.” (respondent from the Municipality of Utrecht)

According to the respondent from the municipality, the added value of MaaS lies in the combination of public transport with other forms of mobility. The respondent cast a glance in the future of what MaaS could look like and expressed that MaaS may be an effective means in solving the last-mile problem. According to the interviewee, the transition between modes can be made easier with MaaS, for example having the option for a user to access their car on the basis of their license plate to that the user can book a reserved parking space at a P&R hub. Next, the user can book their shared bicycle. Indeed, as stated by the interviewee from Innovactory, MaaS can be of added value because of the convenience of having all transport options in one app:

“The added value of MaaS, I think, lies in the freedom of choice in the introduction of all the new forms of mobility to the traveller, at one glance with one app. (...) Soon you’ll have four shared scooter [apps] in the Netherlands, maybe there will be more soon. E-bikes are also increasing, if steps are included, you will get mad! (...) As traveller, as user, I think you are looking for one app where you can find everything.” (respondent from Innovactory)

The offer of multiple travel modes in one app can be the selling point of MaaS, but is also its weak point, according to the respondent from Amber, who uses a metaphor to explain his view:

“We make sure there is a service so when we are not there, then you have nothing. If Volkswagen stops building cars, then you don’t have cars. [I]f a dealer stops, that’s fine, then you are going to look for another dealer.” (respondent from Amber)

In the above statement, the respondent uses an example of a person wanting to buy a Volkswagen car. When a Volkswagen car dealer closes, the person will look for another Volkswagen dealer to buy his/her car. But when Volkswagen stops building cars entirely, then that person has no means of buying a new Volkswagen car. Translated to MaaS, the Volkswagen car dealer is the MaaS provider: the provider is dependent on other mobility service providers to have value for a customer. This is not true the other way round: the individual operators are not dependent on a MaaS provider to have value. For example: a user of a shared car can use this service with or without a MaaS app, but when a MaaS app does not include a shared car service, this user will certainly not use the MaaS app. This problem raises two other concerns: is the user interested in the offer on a MaaS app and does the app function well? Regarding the interest of the user, both the respondent from the municipality of Utrecht and Vecore stated that it is very important for a MaaS provider to know what the needs are of the potential clientele. According to the respondent from Vecore, this has not been done sufficiently:

“The user has never been identified. We are all talking about the ‘city dweller’ (...) that looks in his agenda in the morning and gets a notice ‘oh, your train is delayed, please take this scooter, because it’s cheaper, and you will arrive at your [shared] car at this time’. Forget it, nobody wants that, everyone has its fixed travel patterns.” (respondent from Vecore)

This statement contradicts with what the interviewee of the municipality said about the users:

“What MaaS does, is making it easier [and] more accessible for the occasional traveller, the people that do not make a commuting trip every day, but who want to make a trip one time in the week.” (respondent from the Municipality of Utrecht)

The respondents from the municipality and Vecore differ in their view of the target user group. According to the interviewee from Vecore, targeting users who make infrequent journeys is useless, because everyone has fixed travel patterns. The interviewee from the municipality on the other hand thinks that targeting users who make infrequent journeys is better than targeting users who make the same (commuting) trips on a regular basis, since those people have no need for planning their journey. This research can not give any conclusion on which user groups MaaS should target. It does become clear, however, that in the case of Utrecht not all actors are on the same page regarding target user groups. This is a legitimate issue, since trying to create added value is difficult if a target group is not agreed upon. The other concern relating to the added value is that the combination of all the different travel modes requires a complex technical integration, which leads to the next issue.

Integration and responsibility

According to some respondents, the technical integration of all the different mobility service providers proves to be a challenge. For example, as quoted from the respondent from the municipality of Utrecht:

“MaaS, in essence, is digital cooperation, that is the key. Sharing of data is essential. Integrations between parties is essential. (...) Look, sharing data is... I’m talking about digital integration here, is not something that happens spontaneously.” (respondent from the Municipality of Utrecht)

The respondent from Innovactory, the app developer of Gaiyo, had a different opinion, however. According to the interviewee, the sharing of data in itself is not a big problem. The issue has more to do with what happens with that data to ensure a functional MaaS service:

“There are enough API's, whether it is a top-notch API or just a random API that already existed. That’s not the problem, rather it’s the commercial-legal context: what happens then and for whom? Who is going to do what? Who is responsible for what? (...) Are you going to share customer data, so that both us and another party can approach the user? How do you deal with fraudulent users?” (respondent from Innovactory)

The issue of integration thus relates to the theme of responsibility. If, for example, a user commits a crime on a shared scooter, via the MaaS app, what is appropriate?

“Can the provider of shared scooters, is he allowed when he sees that via [the app] to block the user? Is the provider even allowed to get that data from us and with what reason? And how are we going to communicate that with each other? Are you allowed to make a blacklist together?” (respondent from Innovactory)

While these questions remain unanswered and are currently heavily discussed, according to the interviewee from the municipality of Utrecht, they are tied to the relations between the actors.

Collaboration

One of the relations mentioned was between the municipality of Utrecht and Innovactory. Both parties were satisfied, according to the interviewees:

“Cooperation with Innovactory is quite good, I must say. Mutual goodwill, fairly open, open collaboration, also during COVID when they had a rough time. (...) [Looking for] can we continue together, and the fact that it’s a small club makes it easy to engage with.” (respondent from the Municipality of Utrecht)

“The collaboration with the municipality of Utrecht is really good, anyway. They know that we would have liked to see some things different regarding zoning. In hindsight, they themselves would have wanted it [different] too, maybe. Oh well, it’s [written] in the concession, so you’re not going to change that easily.” (respondent from Innovactory)

While the respondent from Innovactory was not satisfied with the parking zones of shared scooters in the city of Utrecht, the respondent appreciated the fact that it would be very labour intensive for the municipality to make changes to the zones. These changes would have to be applied in the systems of all shared scooter companies, which would also take effort.

The respondents from Amber and Vecore referred to the general relations between involved actors relating to the kick-off of the MaaS projects in the Netherlands:

“In the beginning, at the launch et cetera there was lot of contact, a lot of meetings, and now it’s a lot less. You notice that, (...) towards the end of the project we perceive that it seems like there’s less control. In any case, it’s less than in the beginning, however, there is still contact on a regular basis.” (respondent from Amber)

“I joined in the first settings in The Hague together with thirty market parties where [MaaS] was kickstarted with the idea of [a national API]. (...) Everybody was thrilled, of course, because nobody wanted to miss out. They thought: ‘oh there’s 20 million available, that’s nice!’. So the bigger parties, have all neatly signed up. (...) But slowly over time [the enthusiasm] grew less.” (respondent from Vecore)

According to the interviewee from Vecore, the need for a national TompAPI was disputed by some companies, because they had developed their own APIs, which were working fine for them. Also, some companies operated internationally too, and they would have to develop an API exclusive to the Dutch TompAPI.

Another relation that can be discovered is between public transport operators and private mobility service providers. According to the respondent from the municipality, when transport operators are only focussing on their own operations without looking to work together with private mobility service providers, then those operators can see other forms of mobility as a threat, for example shared bicycles.

“However, the question is: is that bad? From societal cost-benefits I would rather have people cycling than sit in a bus. (...) Of course, public transport is essential, really important, people on their bikes is even better, honestly.” (respondent from the Municipality of Utrecht)

The interviewee offered a different perspective:

“If you’re seeing it as part of your own arsenal, so that you’re more like a producer of [all] public transport rather than only public transport, be it tram, bus, metro and shared mobility. Then it’s not cannibalising, but a part of your service where you offer people more alternatives.” (respondent from the Municipality of Utrecht, emphasis added)

Rather than a focus on just bus and train operations, public transport operators should have a more broad view on transport to include all forms of transportation. This topic was not mentioned by other respondents, however.

5.2.3. Government position

All respondents were asked what the best future position of the government should be in MaaS. According to the municipality of Utrecht, there is currently a lot of debate about this question. The interviewee told that the regional governments should make agreements with a number of MaaS providers to cooperate on achieving public goals, such as offering transport for all people and to reduce emissions. This could take the shape of how currently the public transport sector is organised in the Netherlands, via concession periods of ten years. The interviewee had still a lot of questions, however:

“That is my current vision. But I like to be challenged a bit, also by consultancies: what do you have to organise? How do you invite tenders, do we have to do that on a regional level? What is the relationship with the national government, which has to enforce certain things like standards. (...) [The regions] should take more shared mobility, what’s going to result in a conflict with municipalities, because they think they are in charge of that.” (respondent from the Municipality of Utrecht)

The respondent from Innovactory stated that, even though the relation with the municipality of Utrecht was good, they could not have extensive talks with every municipality about MaaS:

“The disadvantage for us is that there are 392 municipalities. We cannot talk with all of them. (...) We are not going to knock on the door by all the municipalities and go on to say: ‘you should arrange MaaS and shared mobility like this and this’.” (respondent from Innovactory)

Like the respondent from the municipality suggested, regional governments could take an active role. One kind (but not the only kind) of regional government is the provincial government. However, the interviewee from Innovactory was not fond of this idea, because the respondent stated that provincial government was already too busy with public transport concessions. According to the respondent, municipalities should work together and in addition, the national government should set up a licensing system:

“Municipalities that make overarching agreements [about] how it should be organised. I can only imagine that there will come a national draft standard license that everybody can adjust as they please (...) for providers of shared mobility services, whereby everybody should get certified to even get the license [to operate] in the Netherlands and that there will come a simpler ‘frame agreement’.” (respondent from Innovactory)

The respondent was sceptical, however, of the time it would take for the national government to realise the importance and take action. The other respondents were also sceptical of the national government and had the opinion that the government should not have a big role.

“What [the government] should do is to treat shared mobility the same as public transport. So that means to write a proposition per area, that is making parking spaces for shared cars out of bus shelters, link the shared bicycle network to the OV-fiets network [of NS], give users discounts.” (respondent from Vecore)

According to the interviewee from Vecore, the prime role of the government should be to accomplish behaviour change by setting the framework within which MaaS providers can operate and giving subsidies to mobility service providers. The interviewee from Amber thought different about the role of the government in accomplishing behaviour change:

“The market parties were kickstarted with help of subsidies. In the end, however, it should be a market party that wants to work on it multiple years and (...) make that behaviour change happen, by making people

aware of that this exists. (...). I think the government should hurl a big sack of money in the world and tell everybody that this exists.” (respondent from Amber)

In the words of the respondent from Amber, the government should mainly provide subsidies for MaaS providers, mobility service providers and public transport providers. These market parties should then bring about the behaviour change. In conclusion, the role and position of the government is still open for debate. This paragraph will now conclude with discussing the governance approach of the municipality of Utrecht.

5.2.4. Governance approach

Together with the province of Utrecht, the municipality of Utrecht joined in the national MaaS programme of the Ministry of I&W.

“We have made agreements with the Ministry. Under conditions, there’s money available. Everyone co-finances, the Ministry finances a part of the 1.9 million euros and the region provides the other half.” (respondent from the Municipality of Utrecht)

Around forty MaaS providers applied and were judged on their worthiness, in line with the ‘MaaS-worthiness requirements’ mentioned in paragraph 5.1.2. Based on their findings, the municipality made an agreement with Innovactory to be the MaaS provider in Utrecht.

“What we did, inherent to all pilots, really, is to set up a public-private partnership, in an informal sense. (...), MaaS providers receive money they can use to take up the development. We have set up a kind of performance budget for the moment you actually realise an effect with the users.” (respondent from the Municipality of Utrecht)

While with some pilots, subsidies for MaaS providers would depend on the number of uses, the municipality of Utrecht chose to take a different approach. Instead, the municipality focuses on the broader goals of the MaaS pilot and to reward the MaaS provider if they contribute to those goals.

Based on the findings from the interviews, the municipality of Utrecht has the *convener* approach. By providing subsidies, the municipality wants to accomplish its broader goals. The municipality also closely collaborates with the MaaS provider and describes this collaboration as a public-private partnership. This leaves room for market parties to operate how they desire, as long as they contribute to the goals of the municipality.

5.3. Summary

For the next part of the research, nine interviews were conducted with the Ministry of I&W and various actors from the MaaS pilot projects of Assen-Groningen and Utrecht. The main results can be found in Table 5. It can be concluded that the two Dutch case studies have a lot in common, which can partially be explained by the fact that both are a part of the national MaaS programme initiated by the Ministry of I&W. One example of this is that in both pilots, the interviewed actors more or less mentioned the same issues. Another example is the same governance approach of the local/provincial governments to the MaaS pilot. The main differences lie in the opinion of the interviewees on the MaaS pilot and on the position of the government in the future, regarding MaaS. Although all interviewees did not have a very positive opinion about the MaaS pilots, the interviewees from the Utrecht pilot were more negative overall. One explanation for this is that some of the interviewees were looking for a financially stable business case while this was not a specific target for the interviewees of the Assen-Groningen pilot. The other important difference between the two case studies is the option of the position of the government

in future MaaS projects. The interviewees of the Assen-Groningen case were more like-minded in the preferred government position than those of the Utrecht case. Some interviewees emphasized the role of local governments, while others only referred to the national government.

Table 5: Main findings of the Dutch case studies

	Assen-Groningen	Utrecht
Contracting authority	Provinces of Drenthe and Groningen	Province and municipality of Utrecht
App developer	Arriva	Innovactory
General opinion on the MaaS pilot	Mixed opinions: from a total failure to an informative experience	Disappointment
Specific issues	<ul style="list-style-type: none"> • Unviable financial model • MaaS is unknown in the Netherlands • Not enough added value for people over existing transport options • Problems relating to technical interoperability • Little cooperation (according to one interviewee) 	<ul style="list-style-type: none"> • Not enough users for a healthy business case • Not enough insight in user target group • (Technical) integration and responsibility • Less involvement of parties in MaaS than in the beginning of the programme
Potential of MaaS ('MaaS could work if...')	<ul style="list-style-type: none"> • Good working technical product • Region-scale • Knowledge of (needs of) customers 	<ul style="list-style-type: none"> • User-tailored offering • Combination public transport and other forms of transport
Opinion on government position in the future	Setting frameworks, giving subsidies, only interfere when necessary to ensure a level playing field	Different opinions. Suggestions include: active role for municipalities, national government should provide subsidies and set a framework
Governance approach	Ministry of I&W: experimenter Province of Drenthe: convener	Ministry of I&W: experimenter Municipality of Utrecht: convener

6. Discussion

The results of the Dutch case studies suggest that MaaS is still a work in progress in the Netherlands. In order to get a more comprehensive insight, however, the results of the Dutch case studies and international case studies will be combined and will be examined using the reviewed literature. A comprehensive summary of the main results from all investigated case studies is presented in Table 6. This chapter establishes links between the empirical results and the academic literature and, in so doing, will provide answers to the sub questions of this study.

6.1. Breaking through

The MLP offers an encompassing lens on the developments in the mobility system. It delivers an explanation on how a system transition works, while taking multiple dimensions into account (Köhler et al., 2009). The *landscape* is the broader passenger mobility system. The landscape consists of multiple *socio-technical regimes*. One of them being of the type of mobility, where the car holds a dominant position. MaaS is a *niche* in the mobility system (Hirschhorn et al., 2019). Trends like environmental concerns and the rise in popularity of the shared economy and flexibility of lifestyle create a window of opportunity for changes to the mobility system, or in other words ‘break through’ (Geels, 2004). The first sub question of this study is therefore ‘*How can Mobility-as-a-Service break through, according to the Multi-level Perspective?*’. The short answer, according to Geels and Schot (2007), is that a niche can break through when it is fully developed. From the examined case studies it becomes clear however, that this is not the case with MaaS. In fact, it can be argued that the case of Helsinki is the only one where MaaS has had so much influence on the mobility system that it has changed it. Compared to the other examined cases, the number of users is much higher and the MaaS app is operational for almost five years now. In the other case studies, the MaaS pilot was much shorter in duration with a lot less users. The conclusion of Geels and Schot (2007) is that when a niche is not fully developed, it does not have the capability of breaking through when a window of opportunity arrives.

However, it can be argued that it does not end here. In contrast to what Geels (2004) and Geels and Schot (2007) would argue, the examined MaaS pilots are or have been influential to the mobility ecosystem. The MaaS pilot of Gothenburg is one of the earliest examples of MaaS and there are a number of studies done including this pilot (i.e. Sochor et al., 2015; Strömberg et al., 2016; Smith et al., 2018b). In the case of Vienna, even though the pilot project stopped after only six months, now there are several MaaS apps available to the public, so MaaS is still going on (Becker, 2022). While in the Dutch case studies, opinions on the course of the MaaS programme are mixed, several interviewees have stated that they learned from the experience. Furthermore, the interviewees did not indicate that at the end of the national programme, MaaS would terminate entirely. In conclusion, even though MaaS still has to be developed some more to break through on an international scale, it still has influenced the mobility system. The MLP however is not able to give a definitive conclusion on its own (Johnstone & Newell, 2018; Hirschhorn et al., 2019), so a deeper look at the actors, their relations and the examined MaaS pilots is needed.

6.2. Actors and relations

The second sub question that will be answered is ‘*What are the relevant actors of Mobility-as-a-Service and the relations between them?*’. Holmberg et al. (2016) provide a model for the relevant actors in the MaaS ecosystem. The CMS service provider can be translated to the initiator of a MaaS programme. In the investigated case studies, the initiator was the national government in the Netherlands, but a

	Gothenburg	Helsinki	Vienna	Assen-Groningen	Utrecht
Initiator	Regional PTA	Maas Global	ÖBB and Wiener Stadtwerke	Ministry of I&W	Ministry of I&W
App-developer	Unknown	Maas Global	Unknown	Arriva	Innovactory
Place in MLP	Niche, but influential for other Maas projects	Niche which influences the socio-technical regime	Niche, but start of other Maas projects in Vienna	Niche, unable to seize the window of opportunity	Niche, unable to seize the window of opportunity
Governance approach	Regional government: lawmaker PTA: convener	National government: from experimenter to lawmaker PTA: provider (under pressure)	Government: lawmaker, though not actively involved in the pilot	Ministry of I&W: experimenter Province of Drenthe: convener	Ministry of I&W: experimenter Municipality of Utrecht: convener
Accomplishments	<ul style="list-style-type: none"> Reduced car use Monitoring of travel behaviour 	<ul style="list-style-type: none"> Relatively high use of public transport Use of other transport modes in combination with public transport Use of Maas higher in areas with good access to public transport 	<ul style="list-style-type: none"> Use of combination of transport modes Reduced car use (by a minority) High level of integration 	Learning experience by involved actors	Learning experience by involved actors
Issues	<ul style="list-style-type: none"> Unexpected behavioural changes Public transport forms an obstacle Revenue loss due to inflexible payment options Poor integration and efficiency 	Not found in analysis	<ul style="list-style-type: none"> Limited daily use No big changes in travel modes End of project because of terminated funding and growing divergencies 	<ul style="list-style-type: none"> Unviable financial model Maas is unknown in the Netherlands Not enough added value for people over existing transport options Problems relating to technical interoperability Little cooperation (according to one interviewee) 	<ul style="list-style-type: none"> Not enough users for a healthy business case Not enough insight in user target group (Technical) integration and responsibility Less involvement of parties in Maas than in the beginning of the programme
Role of the government	PTA restrained by regional government	PTA pressured by national government	Government not actively involved	Government involved in initiating the Maas programme. Currently a public-private partnership	Government involved in initiating the Maas programme. Currently a public-private partnership

Table 6: Overview of the main empirical results

regional PTA or private organisations in the international case studies. This does not mean that the national government was not involved in the international case studies, as will be discussed later in this paragraph. The CMS operator (the manager of the MaaS ecosystem) also differed between the Dutch and international case studies. In the Netherlands, the local or provincial government were at the head of the MaaS pilot projects, while in the international case studies, the CMS operator was the same actor as the CMS service provider. The reason why the Dutch government seems to be more involved will be discussed later in this paragraph. All researched case studies had various mobility service providers, including public transport and various modes of shared mobility modes. The platform service provider is not always known, but can be a public transport operator as well as a different company. Generally, public transport is seen as the backbone of MaaS (also by Holmberg et al. (2016)), although some interviewees of the Utrecht case argued that the car is the backbone, because the car is the primary mode of travel. In light of the goal of MaaS to end the prime position of the car in the mobility system, the question of which mode of travel should be the backbone of MaaS can be debated. Nonetheless, the answer to this debate will have consequences for the relation between public transport and other mobility service providers. If public transport is the key in MaaS, the relations between public transport providers and other mobility service providers can be under tension (Holmberg et al., 2016; Polydoropoulou et al., 2020). In the examined case studies, there is nothing to suggest a strained relationship between public transport and private mobility service providers. In fact, according to one respondent, when public transport operators are open to cooperate with other mobility service providers to accomplish the goal of developing and diffusing MaaS, mobility service providers are not seen as a threat anymore, but as a useful addition (e.g. to solve the last-mile problem). This argument focuses on all actors trying to achieve the same goal instead of all actors focussing on their own operations. From the Dutch case studies, multiple interviewees were positive about the interactions with other actors, including the government. On the contrary, in the cases of Gothenburg and Helsinki, the relation between the regional PTA and the government was not without its difficulties. In the case of Gothenburg, the laws and regulations of the government constrained the ability of the PTA to work with MaaS (Smith et al., 2018b). In the case of Helsinki, the PTA initially did not support the development of MaaS and only started cooperating under pressure from the national government, and the same is true for the taxi branch (Smith et al., 2018a).

Clearly, the position and role of the government deserves more attention. The reviewed scientific literature shows that there is no consensus. Some authors suggest a strong hands-on role for the government (Vij & Dühr, 2022; Hensher et al., 2021; Pangbourne et al., 2020), while others reject this (Ambrosino et al., 2016; Polydoropoulou et al., 2020). An answer to this debate should involve the relations between the government and other actors, as the empirical research shows. In the cases where the relation between the government and the regional PTA was under tension, the government was strongly involved in the MaaS programme, but leaving the development to other parties. This is a contrast with the Vienna case study, where the government was not really involved at all, and the Dutch case studies. From the interviews it becomes clear that the government wants to develop MaaS in cooperation with other parties, as in an informal public-private partnership. At the beginning of the programme, multiple market consultation sessions were held with multiple parties. This involvement of parties in the kick-off of MaaS cannot be seen in the case of Helsinki, where the PTA had not participated (Smith et al., 2018a).

6.3. Governance and performance

6.3.1. Governance approach to the MaaS pilots

When debating the position of the government, the topic of governance is relevant. This offers an opportunity to go beyond terms of 'hands-on' or 'hands-off'. Therefore, the third sub question is '*How do different governance approaches affect the accomplishments and problems of Mobility-as-a-Service?*'. This study uses the six governance approaches from Hirschhorn et al. (2019). What stands out from the examined case studies is that most of the involved (regional) governments of the international cases have the lawmaker approach, while in the Netherlands the national government best fits the experimenter approach. Meanwhile, in the PTA of Gothenburg as well as the local and provincial governments of Utrecht and Drenthe have the convener approach. The question is if this can be seen influencing the performance of the MaaS pilots?

6.3.2. Performance of the MaaS pilots

In order to discuss the performance, it is important to understand that this is not meant as a quantitative measurement. There is no objective criterium of how well a MaaS pilot is performing. Based on content analysis and interviews, however, some things can be concluded about how the MaaS pilots are doing. As has been stated earlier, with the exception of Helsinki, all MaaS pilots are small and do not or did not have a big influence on the mobility system. In the international case studies, reduction in car use and change in travel behaviour have been reported, while in the Dutch case studies, interviewees generally saw the pilot projects as a useful learning experience. Reduction in car use and changing travel behaviour are core principles of MaaS and are seen as the biggest advantages of MaaS (Ambrosino et al., 2016; Giesecke et al., 2016). In this sense, the examined international MaaS pilots seem to have reached this goal and to have met the expectations. On the other hand however, some other advantages of MaaS mentioned by the literature have not been found in the examined case studies and a number of issues can be derived from the research.

The first main issue concerning MaaS is strongly related to its business model. In brief, the success of a MaaS pilot hinges on the success of the platform provider to convince mobility service providers to join the platform (Holmberg et al., 2016). Indeed, in all investigated case studies, except Helsinki⁵, financial issues related to the business case were found to be present. Especially for the interviewed mobility service providers of the Utrecht case, this was a pressing issue. One of the concerns mentioned by some respondents was the relation between a low number of service providers and a low number of users. One of the respondents explained this problem by making a comparison with a Volkswagen dealer (see paragraph 5.2.2). Jittrapirom et al. (2017) recognise this problem: with a low number of service providers MaaS is unattractive to users, but with a low number of users MaaS is unattractive to service providers. Lastly, the type of business model, as discussed by Vij & Dühr (2022) does not seem to have a big influence on this. However, in order to give a definite conclusion, more mobility service providers should be interviewed.

The second main issue pertains to interoperability. Based on the empirical research, this concept has two sides: a technical side and a relational side. In the cases of Gothenburg, Assen-Groningen and Utrecht technical integration was found to be an issue. According to some other respondents, however, the real issue with interoperability lies in the willingness to cooperate. Indeed, Polydoropoulou (2020)

⁵ In the case of Helsinki, no issues have been found from the content analysis. This is not to say that there really are no issues, but there is a lack of objective research. The widely used report of Hartikainen et al. (2019) is related to the organisation of the MaaS app itself and cannot be seen as scientific. However, other than the report, no numerical result analysis could be found.

found this to be a pressing issue. As has been said earlier, however, in the Dutch case studies, the government was much more focused on cooperation than regulation. A lack of cooperation can then be seen as a bigger problem than in cases where there is less emphasis on collaboration. Since with MaaS a lot of actors are involved, good cooperation seems to be a determining factor in the performance of MaaS. Although no hard conclusions can be drawn, the fact that one of the main reasons of the end of the Vienna MaaS pilot was growing divergencies between ÖBB and Wiener Stadtwerke, serves as an example.

The next issue mentioned in the literature is equity (Polydoropoulou et al., 2020; Pangbourne et al., 2020). This problem seems not be present in the investigated case studies. In fact, the Dutch Ministry of I&W seems to be aware of the risk of equity problems with MaaS, hence the focus on Wmo transport in the case of Assen-Groningen. This is understandable, since MaaS is very user-centric (Jittrapirom et al., 2017). This leads to the next issue discussed in the literature: since MaaS is so user-centric, what is the added value of MaaS to the user? If the end-user cannot be convinced of the improved convenience of using a MaaS app, he/she will potentially not make use of it (Giesecke et al., 2016; Sakulyeva, 2020; Hensher et al., 2021). From the international case studies, no answer can be derived, but this topic was central in the interviews with the Dutch case studies. Some interviewees mentioned that MaaS is unknown in the Netherlands and that the added value of MaaS is limited, because of the well-functioning public transport system. On the other hand, however, other interviewees were convinced that MaaS has added value above journey planner apps like Google Maps. Even though Google Maps may start a MaaS platform, according to some respondents, the ability of a regional MaaS provider to make tailored offerings to users is a unique selling point. This, however, circles back to the issue of interoperability, since there must be good technical integration and cooperation to live up to this promise. Again, if the (potential) users of MaaS cannot be convinced of the convenience, they will likely not make use of it (Giesecke et al., 2016; Sakulyeva, 2020; Hensher et al., 2021). What becomes clear is that the topic of added value does not only concern added value for users, but that big tech companies, like Google, are seen as potential competitors on the MaaS market, not only by the interviewed MaaS providers, but also the Dutch government.

6.3.3. Comparing governance to performance

Overall, there is no direct relation between the governance approach on the one hand and the performance of a MaaS pilot on the other hand. Matters like business case, technical integration, cooperation and added value seem more relevant to the performance of MaaS. Even though the governance approaches of governments and regional PTAs are different throughout the MaaS pilots examined in this research, most MaaS pilots had the same issues. The same goes for the accomplishments, which do not seem to be dependent on the governance approach of governments and regional PTAs. What does seem to matter, however, is the role of the government and their relation to other actors.

6.3.4. The role of the government

As has been stated before, there is a debate in the literature whether the government should have a strong position to combat the issues of MaaS or not. Regarding the examined case studies, in all cases, except for Vienna, the government (national and/or local) was actively involved in the MaaS pilot. This in itself, however, does not tell the whole story. In the cases of Gothenburg and Helsinki, the government was either restraining or forcing the regional PTA regarding MaaS development, while in the Netherlands, the government was actively trying to work together with market parties. In the case studies of Assen-Groningen and Utrecht, several interviewees regarded the relation with the national and local government to be good. A probable cause might be the early-stage involvement of multiple

parties in the MaaS programme. One of the reasons of the tensions between the government of Finland and the PTA of Helsinki is that the PTA has not been involved in MaaS since the beginning (Hirschhorn et al., 2019; Audouin & Finger, 2019). Even though the examined Dutch MaaS pilots were not regarded as a success, the interviewees generally looked at the pilots as a useful learning experience, which has not been found to be the case in the international case studies. An early involvement of market parties with an engaged government during the MaaS programme may be one of the reasons of this more positive outlook.

A collaboration between government and market parties seems to be preferable then, but how should this look like? A study by Fenton et al. (2020) found that involvement of the local government was seen as desirable by stakeholders in facilitating and supporting MaaS developments. The study also suggested government involvement on higher government levels to support diffusion and upscaling. Based on the examined case studies, however, whether the government was strongly involved or not at all did not seem to matter with regard to the diffusion and development of MaaS. According to several respondents of the Assen-Groningen and Utrecht case studies, the national government should set the frameworks wherein market parties can operate and give subsidies to help the development of MaaS. Municipalities or provinces could also take on a more active role by cooperating in making regulations for MaaS providers.

In conclusion, the sub question *'How do different governance approaches affect the accomplishments and problems of Mobility-as-a-Service?'* can be answered as follows. This research has not found a direct link between governance approaches and the accomplishments and problems of MaaS. Since collaboration is important in the multi-actor ecosystem of MaaS, a public-private partnership is suggested with early involvement of market parties and an engaged government setting frameworks for market parties to operate within and give subsidies for the development of MaaS.

7. Conclusion

7.1. MaaS and the mobility landscape

Currently, cars are the dominant mode of transportation. The negative effects of this give urge to the need for a more sustainable mobility landscape. The concept of MaaS has the promise to change travel behaviour of people by making it easier to use sustainable modes of transportation by integrating them in one digital interface (Jittrapirom et al., 2017; Heikkilä, 2014). But since MaaS is a relatively new development, if it can fulfil its promise remains unclear, which leads to the central question of this research: *To which extent does Mobility-as-a-Service support sustainable mobility transition?*

Using the MLP of Geels (2002), it becomes clear that MaaS is a niche in the mobility landscape trying to break through. In order to break through, MaaS must be fully developed. Geels and Schot (2007) present four proxy indicators of when a niche is fully developed. From the research it becomes clear that MaaS is not fully developed: even though powerful actors are involved, the details of MaaS programmes differ, as can be seen in the slightly different focus points of the Dutch case studies, and only in the case study of Helsinki can it be stated that MaaS has influenced the local mobility system. The MLP does not consider, however, the role of actors and their relations, as well as the role of the government (Johnstone & Newell, 2018; Hirschhorn et al., 2019). The model of Holmberg et al. (2016) is used to explain the different involved actors in MaaS. In the examined case studies, different actors were involved as being the initiator of the MaaS pilot, but in almost all cases the government was involved. The relations between the various actors can be described as good in general, but this was not always the case with the relation between the government and other actors. A look into governance is therefore necessary to understand the position and role of the government. This study made use of the model of Hirschhorn et al. (2019) who came up with six approaches. Even though some differences were noticed in governance approach, it is not possible to relate this to differences in accomplishments and problems in the case studies. Even though in some cases the MaaS programme saw changes in travel behaviour, some major issues were also found. Especially for the Dutch case studies, the COVID-19 pandemic seems to have curtailed the development and diffusion of the MaaS apps.

Clearly MaaS is not yet breaking through and providing a big support to sustainable mobility transition. But the discussed models of MLP, involved actors and governance approaches cannot provide an explanation on what's missing. As discussed before, the performance of the MaaS programmes did not reflect differences in governance approach, although the role of the government and relations between actors is important (Jessop, 1998; Rhodes, 2007). In some case studies there was tension between the government and the regional PTAs or mobility service providers. Interviewed respondents from the Dutch case studies, however, were quite positive about the cooperation with the government and saw an important role for the government in MaaS. Therefore, it is the conclusion of this study that although a supportive role of the government, while leaving space for the market to operate in, cannot 'fix' MaaS, it is the cornerstone of a further development of MaaS towards supporting the sustainable mobility transition.

7.2. Reflection

The promise of MaaS to change travel behaviour towards sustainable mobility stands in stark contrast with its performance, at least that of the examined case studies. Is the opinion of Giesecke et al. (2016) justified? Is MaaS nothing more than a hype, a patchwork of optimistic political dogma and activists' enthusiasm? This is a question too big for this research, but this research shows that MaaS is still in development. Although the pilot project in Gothenburg had little impact, it is seen as influential for the

development of MaaS (Smith et al., 2018b). Although the project in Helsinki involved some conflict between the regional PTA and the national government, MaaS definitely has an impact on the travel behaviour of its users (Hartikainen et al., 2019). Even in Vienna, where the MaaS pilot project stopped due to financial and relational reasons, MaaS is still active, albeit with other platforms (Becker, 2022). In the Dutch case studies, the will to continue is still present, seeing the experiences with MaaS as fruitful. From this research, it also becomes clear that MaaS is a concept that requires an active collaboration between the involved actors, with clear communication about expectations. It is important to remember that MaaS is a means to achieving a more sustainable mobility ecosystem, and not an end in itself.

As stated before, the MLP model has some limitations, which this study filled in by including the concept of governance. However, the six governance approaches of Hirschhorn et al. (2019) are not perfect either. As is shown in the case of Helsinki, the PTA has a lawmaker approach, but only because it is forced to be involved in MaaS by the national government (Smith et al., 2018a). Surely, the way of approaching MaaS must be different then when the PTA was involved of its own accord, from the very beginning of MaaS in Helsinki. But the model of Hirschhorn et al. (2019) does not leave space for this, the model is insensitive for relations. Although the model is certainly very useful, this necessitates further research into relations between actors, as is done in this study.

This research has some limitations of its own that need to be addressed. The main limitation is that no users of MaaS were interviewed. Because of privacy legislation in the Netherlands, it was not possible to obtain any information about users, so there was no way to identify users of MaaS. This is still very important when researching MaaS. Interviewing all involved actors and users gives a more complete overview than has been possible to give in this research. Another weak spot of this study is its reliance on other studies on the international cases. This can be a problem as for the case of Helsinki, no objective independent data was found. In the used report, no issues of MaaS were presented, but seeing the other case studies, it is highly unlikely that there were no issues in Helsinki at all. Several authors relied on the report of Hartikainen et al. (2019) for their data on the Helsinki project, so it is suggested that there is a need for independent data on the performance of MaaS in Helsinki. The next limitation of this study is its lack of mobility service provider respondents. Only two were interviewed, but there are a lot of different service providers involved in MaaS. Several potential respondents declined the invitation because of high workload. Since most of the shared mobility service providers are small companies this can be explained, but that does not take away the fact that a study with more interviews with mobility service providers has added value.

Besides methodology related suggestions for future research, there are a few suggestions based on the findings of this research. The first is that the governance approach model from Hirschhorn et al. (2019) is not enough to explore relations between actors. It is very useful to define the approach of the government to MaaS, but what the relation is between the government and other actors is not included in the model. Another suggestion for further research is on the knowledge among the general public of MaaS. As is stated by some interviewees, one of the reasons of the low uptake of MaaS in the Netherlands is that the concept is still unknown. A possible research topic could therefore be how to increase the uptake of MaaS among the general public. When MaaS is a more known concept, it has more chance to escape the criticism of being a hype and to really deliver on its promise of a more sustainable transportation system.

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Appendices

Appendix 1 – Topic lists

Topic list interview Amber

1. Waarom heeft Amber besloten om mee te doen met deze MaaS pilot?
2. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Bent u tevreden over het aantal gebruikers?
 - b. Wat is uw mening over de business case?
3. Hoe vindt u de samenwerking verlopen met de andere betrokken partijen?
 - a. Op het gebied van delen van data en integratie?
 - b. Samenwerking met overheid?
4. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
5. Hoe zou volgens u de overheid zich moeten opstellen?

Topic list interview Arriva employee 1

1. Waarom heeft Arriva besloten om mee te doen met deze MaaS pilot?
2. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, business model e.d.
3. Hoe vindt u de samenwerking verlopen met de andere betrokken partijen op het gebied van delen van data?
 - a. Zou u voorstander zijn van een nationale API?
4. Wat is uw mening met betrekking tot de integratie van partijen in de MaaS pilot?
 - a. Aspect aansprakelijkheid en verantwoordelijkheid
5. Wat vindt u van de rol die de Nederlandse en provinciale overheid neemt in deze pilot?
6. Wat zijn volgens u de sterke en zwakke punten aan het MaaS concept?

Topic list interview Arriva employee 2

1. Waarom heeft Arriva besloten om mee te doen met deze MaaS pilot?
2. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, business model e.d.
3. Hoe ziet de samenwerking met de andere betrokken partijen er concreet uit? (wie doet wat)
4. Hoe vindt u de samenwerking verlopen met de andere betrokken partijen?
 - a. Aspect aansprakelijkheid en verantwoordelijkheid
 - b. Samenwerking met de overheid
5. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
6. Hoe zou de overheid zich in de toekomst moeten opstellen voor MaaS?

Topic list interview Arriva employee 3

1. Waarom heeft Arriva (Glimble) besloten om mee te doen met deze MaaS pilot?
2. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, business model e.d.
3. Hoe vindt u de samenwerking verlopen met de andere betrokken partijen?

- a. Op het gebied van delen van data en integratie?
- b. Samenwerking met overheid?
- 4. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
- 5. Hoe kan volgens u een app ontwikkelaar, zoals Glimble (Arriva), inspelen op de sterke en zwakke punten van MaaS?
 - a. Hoe zou volgens u de overheid zich moeten opstellen?

Topic list interview Innovactory

1. Waarom heeft Innovactory besloten om mee te doen met deze MaaS pilot?
2. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, business model e.d.
3. Hoe ziet de samenwerking met de andere betrokken partijen er concreet uit? (wie doet wat)
4. Hoe vindt u de samenwerking verlopen met de andere betrokken partijen?
 - a. Op het gebied van delen van data en integratie?
 - b. Samenwerking met overheid?
5. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
6. Hoe kan volgens u een app ontwikkelaar, zoals Innovactory, inspelen op de sterke en zwakke punten van MaaS?
 - a. Hoe zou volgens u de overheid zich moeten opstellen?

Topic list interview Ministry of Infrastructure and Water Management

1. Wat is het doel van de MaaS pilots in Nederland?
 - a. Waarom heeft het Ministerie van I&W besloten tot deze pilots?
2. Wat is de rol van het Ministerie van I&W?
3. Wat is de verhouding tussen het Ministerie van I&W en de andere partijen die betrokken zijn bij deze pilot?
 - a. Hoe vindt u de samenwerking verlopen tussen het Ministerie van I&W en de andere betrokken partijen?
4. Hoe vindt u de pilots in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, delen van data tussen vervoerders e.d.
 - b. Denkt u dat de doelen van deze pilots worden gehaald? Waarom wel/niet?
 - c. Focus op de pilots Assen-Groningen en Utrecht
5. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
6. Zijn er signalen van problemen rond ongelijkheid met MaaS?
 - a. Zoals ongelijke toegang (fysiek en digitaal) tot MaaS
7. In hoeverre is de overheid bereid om eventuele financiële tekorten aan te vullen?
8. Hoe kan de nationale overheid inspelen op de sterke en zwakke punten van MaaS?
 - a. Ziet u hier een sterke rol voor de nationale overheid weggelegd of juist een kleine rol? En wat is de rol voor regionale en lokale overheden?
 - b. Wat is dan de positie van marktpartijen?

Topic list interview Municipality of Utrecht

1. Wat is het doel van deze MaaS pilot?
 - a. Waarom heeft de gemeente Utrecht besloten om mee te doen?
2. Wat is de rol van de gemeente Utrecht?
3. Wat is de verhouding tussen de gemeente Utrecht en de andere actoren die betrokken zijn bij deze pilot?
 - a. Hoe vindt u de samenwerking verlopen tussen de gemeente Utrecht en de andere betrokken partijen?
4. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, delen van data tussen vervoerders e.d.
 - b. Denkt u dat het doel van deze pilot wordt gehaald? Waarom wel/niet?
5. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
6. Hoe kan de gemeente Utrecht inspelen op de sterke en zwakke punten van MaaS?
 - a. Ziet u hier een sterke rol voor de overheid weggelegd of juist een kleine rol?
 - b. Wat is dan de positie van marktpartijen?

Topic list interview Province of Drenthe

1. Wat is het doel van deze MaaS pilot?
 - a. Waarom heeft de provincie Drenthe besloten om mee te doen?
2. Wat is de rol van de provincie Drenthe?
3. Wat is de verhouding tussen de provincie Drenthe en de andere actoren die betrokken zijn bij deze pilot?
 - a. Hoe vindt u de samenwerking verlopen tussen de provincie Drenthe en de andere betrokken partijen?
4. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Denk aan zaken als: aantal gebruikers, afname autogebruik, aanvulling op bestaand openbaar vervoer, delen van data tussen vervoerders e.d.
 - b. Denkt u dat het doel van deze pilot wordt gehaald? Waarom wel/niet?
5. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
6. Hoe kan de provincie Drenthe inspelen op de sterke en zwakke punten van MaaS?
 - a. Ziet u hier een sterke rol voor de overheid weggelegd of juist een kleine rol?
 - b. Wat is dan de positie van marktpartijen?

Topic list interview Vecore

1. Waarom heeft Vecore besloten om mee te doen met deze MaaS pilot?
2. Hoe vindt u de pilot in zijn algemeen tot nu toe verlopen?
 - a. Bent u tevreden over het aantal gebruikers?
 - b. Wat is uw mening over de business case?
3. Hoe vindt u de samenwerking verlopen met de andere betrokken partijen?
 - a. Op het gebied van delen van data en integratie?
 - b. Samenwerking met overheid?
4. Wat is volgens u de toegevoegde meerwaarde van het MaaS concept?
 - a. Waar liggen volgens u de pijnpunten van MaaS?
5. Hoe zou volgens u de overheid zich moeten opstellen?

Appendix 2 – Used codes

Name	Description
Approach	Governance approach
Government position	Opinion on the ideal government position regarding MaaS
Introduction	Respondent gives an introduction to the MaaS pilot and their relation to the pilot
Activities	Role and activities of (private) actors in a MaaS programme
Goal	Goal of the MaaS pilot project
Join	Reason for joining the MaaS pilot
Issue	Perceived issues with the pilot
Finance	Financial/business model related issues
Government	Issue related to the position/acting of the (local) government
Interoperability	Issues related to poor integration and interoperability
Responsibility	Issues related to responsibility and legal-commercial issues
Technofix	Issues related to a technofix approach from the government and equality related issues.
Value	Perceived (aggregated) value of MaaS
Relations	Relations with other actors
Collaboration	Collaboration with other actors
Results	Opinion on how the MaaS pilot is performing
Goal achieved	Is the set goal of the MaaS pilot achieved?