Governing MaaS

The governance of Mobility as a Service in the municipality of Amsterdam

Master's thesis Spatial Planning
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Colophon

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All that remains for me to do is to wish you, the reader, an inspiring read.

Maud Poels

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Abstract

Mobility as a Service is increasingly referred to as a solution to mobility systems that are under pressure and reached their maximum capacity, and to face the mobility problems that are experienced. MaaS is namely believed to be a new mobility paradigm with which mobility systems should become more sustainable and efficient. This new paradigm causes fundamental shifts in how mobility is organised and used, and how cities function. A new governance model is then required to manage the mobility systems. In this research, therefore, the impact of MaaS on the governance of the mobility system of Amsterdam was examined. By using multiple qualitative research methods – document analysis, stakeholder workshops, and semi-structured interviews – the research questions have been empirically investigated.

The outcomes demonstrate that Amsterdam has drawn up various goals to achieve with MaaS. The priority is to place users at the centre of the mobility organisation. But in addition, the municipality has established various social and policy objectives that it wants to achieve with MaaS to make the city more attractive and liveable. MaaS should herein be seen as a tool that facilitates the transition to a new mobility system, but MaaS cannot achieve all of these goals individually. Accordingly, MaaS introduces three new elements to the mobility organisation, which bring several governance implications. The socio-technical constellation is changing as new roles, tasks and responsibilities emerge, making the ecosystem severely complex. Collaboration between the actors is therefore of significant importance. This collaboration will however not emerge by itself. Next to this, data is the most valuable commodity in MaaS for both private and public actors. There is, however, a data asymmetry whereby the private actors possess the data but are unwilling to share this with public actors. Finally, MaaS changes the spatial arrangements since the physical infrastructures and the public space are inextricably connected to MaaS. Currently, however, MaaS and the spatial environment do not correspond, and a spatial mismatch exists. Additionally, there is an implication concerning legislation. The mobility organisation is currently namely compartmentalised, meaning that mobility cannot be approached integrally, which inhibits the development of MaaS.

These new elements and their related implications, therefore, require a change in governance. In the Netherlands, a public-private governance model is applied, in which public and private actors jointly develop MaaS, wherein all actors have their own tasks and responsibilities. In the initial development phase, a heavier role is temporarily foreseen for the municipality of Amsterdam. By being more present at the start, the government can, as a facilitator, use its instruments to create the right circumstances for MaaS to develop by adapting current policies, drawing up frameworks for collaboration, making certain rules and agreements in concessions and permits, and creating digital infrastructures and promoting data sharing. In this way, the municipality can stimulate the development of MaaS and establish an open, healthy and transparent ecosystem and protect the social goals and public values.

Keywords: Mobility-as-a-Service, Digital platforms, Governance, Urban Political Economy, Platform Urbanism

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Abbreviations

MaaS	Mobility as a Service
PT	Public transport
PE	Political economy
UPE	Urban political economy
PU	Platform urbanism

1. Introduction

Worldwide, cities are facing a rising demand for mobility, which is increasingly putting pressure on mobility systems and transport infrastructures. This increasing pressure on the mobility systems also puts the liveability, traffic safety and accessibility of cities under ever-increasing pressure (Walther Ploos van Amstel, 2021). With the current growth rate of cities, according to the United Nations Department of Economic and Social Affairs (2015), the mobility systems will soon reach their maximum capacities (Ministerie van Infrastructuur en Waterstaat, 2019a), but the conventional approaches where the mobility needs are countered by expanding the infrastructures are no longer considered a (sustainable) solution for cities. This would result in adverse effects not only on the economic development of cities but also on people's health and the quality of the environment and nature (PBL, 2021). This is why necessary steps must be taken to adapt, innovate and future-proof mobility (Ministerie van Infrastructuur en Waterstaat, 2019a).
It is herein expected that the future developments of mobility will be largely influenced and formed by technology (Kaptijn, 2017). Technology plays an increasingly important role and is getting more intertwined in all aspects of our society (Kaptijn, 2017). This is also why the trend of digitalisation forms the basis for many future plans, and why it is a focal point for future-proofing mobility to drive innovation, aimed at accessibility in cities and flexible demand-oriented mobility (TNO & ARUP, 2018). In mobility, the application of innovative technologies can provide more efficient mobility systems (Bouton, Hannon, Knupfer & Ramkumar, 2017). This has already been proven in the past where significant advances in technology have already caused multiple transport revolutions (Jones, 2014).

The increasing pressure on mobility systems and the innovative role of technology in mobility have recently led to a growing interest in Mobility as a Service [MaaS]. MaaS is a very young and innovative concept that is increasingly being presented as one of the most promising solutions to societal mobility problems (Lauwers, 2015). The underlying rationale for this is that MaaS combines mobility services in an attractive and accessible way, enabling users to satisfy their travel needs without owning cars. MaaS can then support a modal shift away from privately owned and used cars (Smith, 2020). This way, MaaS is claimed to not only offer support in personal mobility improvement but it is believed also to contribute to the creation of efficient mobility systems and to the sustainability transition of mobility (Smith, 2020).

While there are many different definitions derived from MaaS, there does not yet exist a universally shared definition. The definition that will be applied in this research originates from the European Metropolitan Transport Authorities;

> "*With Mobility as a Service, customers fulfil and manage all their mobility needs on demand, based on their general preferences and journey-specific needs. The service is based on the seamless integration of all different public and commercial modes of transport and is delivered via a digital interface. The service must enable multimodal travel possibilities and thus allow for the planning and booking of multimodal journeys, support on the go and payment as well as alteration of the planned journey. MaaS also generates insights into demand, needs and travel behaviour for cities and authorities, allowing for more targeted and effective adaptations of services and investments in infrastructure".*
>
> (EMTA, 2019, p. 5)

From this definition, it becomes clear that MaaS relies on a digital platform. In this, the digital interface is an essential component of MaaS. With MaaS, a pivot to platforms is taking place, with users becoming increasingly dependent on platforms for mobility (Barns, 2019). MaaS specifically is expected to start a new transport revolution in which a transition towards a more sustainable mobility system will

commence, which consequentially also influences the functioning of the city (Audouin & Finger, 2018). MaaS is namely claimed to be a new transport paradigm, that refers to introducing a new mobility system that breaks with the current system which is focused on private car ownership (Rantasila, 2015; Audouin & Finger, 2018). The claimed envisioned effect for its users will then bring evolutionary changes to how current and emerging mobility infrastructures and vehicles are used and accessed (Lyons, 2018). The transport revolution MaaS is anticipated to erupt, also causes fundamental shifts in how mobility services are used and produced, in regard to increased inter-organisational collaboration and an increasing role for data. MaaS will change existing relations herein, introduce new roles and actors to the operational value chains, and partly rely on the use of data (Smith, 2020). New perspectives on the operation and needs then also require new ideas on how to develop urban areas and will be influenced by the formation of urban areas. Nevertheless, new concepts like MaaS are also seen as preconditions to enable the growth of the cities and regions (Metropoolregio Amsterdam, 2021).

It is expected that MaaS can thus offer a possible solution to numerous societal and mobility problems at hand. However, to start realising and implementing MaaS, new governance structures and processes will be needed. Herein there are important organisational lessons to be learned about the legal conditions, the relationship between involved actors and the governance culture, data, and urban infrastructures. This is why multiple experiments and pilots are currently being conducted, aiming to gain the experience that is needed to apply MaaS (Vervoerregio Amsterdam, 2021).

A new aspect of the governance of MaaS concerns the notoriously complex ecosystem. The implementation of MaaS involves many organisations and stakeholders creating a complex multi-actor ecosystem. In this system, all actors have their own goals, beliefs, principles, and behaviour which are all important in creating a balanced ecosystem (Tsujimoto, Kajikawa, Tomita & Matsumoto, 2018). The coordination of this complex ecosystem requires new governance structures that will influence the implementation, actor roles and responsibilities, and collaborations (TNO, 2020), and is seen as a significant challenge for MaaS (Audouin & Finger, 2018). Due to the complexity of the ecosystem and the challenge this poses, the cooperation and partnerships between actors are critical for developing and implementing MaaS. But aside from the complex ecosystem, the digital technologies and data which are part of MaaS also introduce a new dimension to the conventional planning practices, affecting the governance of planning (Van den Hurk, Pelzer & Riemens, 2021). And as the technological change is outpacing the capacity of the current governance of mobility systems to respond to these challenges, it is of great importance that these new governance issues are addressed in time. MaaS, the complex ecosystem and role of data then also introduce a new dimension regarding the spatial arrangements of the mobility system. MaaS namely influences the development of physical space, as well as physical space influences the development of MaaS. In order to then manage the physical urban space, and in a broader sense MaaS and the mobility system, the governance is required to adapt.

For sufficient implementation, adequate collaboration in the actor field requires matching responsibilities and roles of all government layers. And there is a broad market demand for clarity regarding MaaS, in which the government is recognised as having a regulatory role (Docherty, Marsden & Anable, 2018; Van den Hurk et al., 2021). However, questions remain unanswered about how far the authority and regulatory role of different government levels should extend (Vervoerregio Amsterdam, 2021; European Commission, 2020). It is herein important to recognise that the governance of MaaS is not dichotomous between state-led regulation or laissez-faire (Pangbourne, Stead, Mladenovic, Milakis, 2018). If governance is not adjusted and aligned with this new mobility system, consequences could cause the mobility systems to be locked in transition paths which exacerbate societal and environmental problems that challenge the mobility system (Docherty, et al., 2018). It is then essential to adjust the

governance structure to define what needs to change about the current mobility systems, which instruments and resources are required to execute this, and what role the governmental actors should take (Docherty et al., 2018; Smith, 2020). To reach the foreseen improvements and societal goals, there needs to be clarity on how the implementation of MaaS will affect the governance of Amsterdam's mobility system.

1.1 The case of Amsterdam

The city and region of Amsterdam have been experiencing substantial growth. And it is predicted that the growth will keep increasing, consequently increasing the pressure on public spaces and the impacts on liveability and accessibility. Because of the growth, the mobility pressure is high, the infrastructure is overloaded, and the air is polluted (Amsterdam, n.d. a). The city of Amsterdam strives to reduce traffic congestion in the city and aims to discourage car ownership to reduce these negative externalities (EIT Urban Mobility, 2020). This is why the municipality of Amsterdam aims to apply new mobility concepts like MaaS, to attempt and find clean and smart solutions for the mentioned social challenges and to enable the growth of the city and region (Gemeente Amsterdam, n.d. b). By introducing MaaS they however also aim to make the mobility system more accessible and inclusive and generally increase the efficiency of the mobility system. It is expected that MaaS can in this regard contribute to strategic mobility assignments such as smarter use of space, a safer and more inclusive mobility system and more sustainable mobility when a certain government role is assumed (Vervoerregio Amsterdam, 2021).
Currently, no concrete shift towards MaaS has taken place yet in Amsterdam. The city is however actively involved in pilots and experiments to facilitate MaaS and gain experience in order to understand in what way MaaS can possibly contribute to the different policy goals (EIT Urban Mobility, 2020).

1.2 Research objective and research questions

The primary aim of this master's thesis is to understand what the introduction of MaaS means for the governance of the mobility system. This is specifically examined within the context of the city of Amsterdam and its mobility system. MaaS namely introduces new elements, being the socio-technical constellation, the data and its value and the spatial arrangements. These new elements do not fit with the current organisation of mobility systems in Amsterdam and cause implications for the governance. In order to manage and steer the mobility system with the arrival of these new elements, the governance will have to change. By elaborating on how the new elements of MaaS influence the mobility system and its governance, insight will be created into how the governance will have to change and what Amsterdam can do to manage the mobility system optimally.

This research shall look at the governance primarily from the perspective of the city of Amsterdam. The reason for this is that the public sector is often characterised as the key enabler and benefactor of MaaS developments (Utriainen & Pollanen, 2018) in which the public transport [PT] authorities are identified as fundamental for MaaS experiments and the PT is seen as the backbone of MaaS (Polis, 2019; Smith, 2020). The public sector consequently has key roles in the MaaS development disregarding how these may unfold. Furthermore, public sector actors like the municipality and the PT authority have a growing interest in MaaS and prefer to accelerate its implementation. Besides this, the municipality and PT authority want to participate in the development of MaaS to influence the formation, in order to protect the societal and policy goals that they try to achieve with MaaS. However, since there are few practical applications to base MaaS strategies on, there is a high demand for knowledge of how public sector actors can steer on MaaS and how the governance is affected. This research, therefore, aims to create more knowledge for Amsterdam on how to govern MaaS.

In order to achieve this objective, the following research question will be central in this master's thesis:

What does MaaS mean for the governance of Amsterdam's mobility system?

Accordingly, to answer this research question the following sub-questions have been formulated:

1) Why is MaaS of interest to the city of Amsterdam and what are the municipal goals for MaaS in Amsterdam?
2) What is distinctive about MaaS processes and what do they mean for the provision of mobility?
    a) What is the socio-technical constellation of Amsterdam's MaaS?
    b) What is the role of data in creating value for Amsterdam's MaaS?
    c) How is the Amsterdam MaaS platform co-constituted with urban space?
3) Given these characteristics, how could municipalities govern MaaS to ensure public value & equitable access to mobility*?*

1.3 Relevancies

1.3.1 Social relevance

MaaS can offer a potential solution and contribute to solving several societal challenges. With the deployment of MaaS, Amsterdam wants to create a more liveable city by specifically focusing on several key principles. These principles are aimed at reducing the pressure on the mobility network, creating a high-quality and inclusive mobility system, reducing the amount of space taken up by the mobility system, and creating a more sustainable mobility system (Vervoerregio Amsterdam, 2021). Amsterdam further aims to expedite the transition of ownership to utilisation of mobility by enticing users to travel in a clean and smart way by using a digital app which offers a diverse mobility supply, travel advice and payment options (Gemeente Amsterdam, 2022).
Additionally, on a national scale MaaS is seen as a means to achieve societal goals and public interests. The ambition is to ensure a safe, sustainable, and resilient mobility system wherein the impact on the living environments is minimal and where the user is central (Ministerie van Infrastructuur en Waterstaat, 2019a; Programma Toekomstbeeld OV 2040, 2019). By focusing on the user, the mobility system should be easier to use and should improve social inclusivity, which creates the possibility for people to be mobile and fully participate in society. However, without the appropriate governance and steering, the current challenges of the mobility system may be aggravated. The mobility systems will then experience even more pressure, will not be inclusive or accessible, mobility will become more expensive and there will be a growth of (geographical) inequality in mobility supply (Programma Toekomstbeeld OV 2040, 2019).

To realise the implementation of MaaS and achieve the societal goals, an adaptation of the governance is thus needed. Multiple governance aspects such as the changing networks of actors, changing relationships, power and resources, and the regulation of mobility all affect the safeguarding of societal goals and public interests (Docherty et al., 2018, Van den Hurk et al., 2021). It is therefore important that MaaS is introduced and governed in the right way (Vervoerregio Amsterdam, 2021).

In addition, the transport sector is currently one of the largest contributors to air pollution and CO_2 emissions, and the largest cause of unsustainable patterns in urban areas. The negative impact of transport activities therefore increasingly outweighs the benefits. Not only through emissions but also through accidents, traffic congestion, energy consumption and other environmental impacts (Moradi & Vagnoni, 2018). Therefore, concepts such as MaaS aim to achieve a shift towards sustainability, especially in urban areas that are currently filled with private mobility that is not used efficiently (Vervoerregio Amsterdam, 2021). In order to actually achieve a more sustainable mobility system

through MaaS, it should be incorporated into relevant policies (Pangbourne, Mladenović, Stead & Milakis, 2020).

This research investigates how the city of Amsterdam can govern MaaS to ensure public values and equitable access to mobility. In this way, this research contributes to creating insight into how MaaS can achieve maximum societal contribution.

1.3.2 Scientific relevance

MaaS is a highly innovative and new concept in the academic science of mobility. However, despite its short existence, MaaS has generated interest in the academic world, resulting in a rapidly growing body of literature on MaaS (Hirschhorn, Paulsson, Sørensen & Veeneman, 2019). Nonetheless, currently, the research on the governance of MaaS developments, in particular focusing on more specific cases, is heavily underdeveloped and points out a research gap (Fenton, Chimenti & Kanda, 2020). Exceptions are among others Audouin and Finger (2018) who researched Helsinki, and Smith, Sarasini, Karlsson, Mukhtar-Landgren, and Sochor (2018a) who researched Sweden and Finland. Hereby there still seems to be a large research gap in the academic literature on the governance of MaaS development (Audouin & Finger, 2018).

This master's thesis places itself thoroughly within the gaps of the present-day academic literature and contributes significant knowledge to the debate on the subject. It adds to the limited amount of literature on the governance of MaaS by researching how the development and implementation of MaaS have an impact on the governance of mobility systems. This thesis will also add to the existing literature by researching the role of governance in MaaS developments by addressing the specific case of Amsterdam. Such a case study on this specific topic has not been conducted to date. Next to this, the research uses an urban political economy analysis to investigate the governance, while drawing on a platform urbanism lens. This analysis framework and lens have not been used before in the academic literature on the governance of MaaS. With this, this research adds to the academic literature by applying a new analysis framework in combination with the specific case study on the city of Amsterdam.

Within the governance of MaaS, the roles of the public sector are poorly understood in academic research. How public sector actors should govern MaaS is still highly under-researched, and the current governance models show incompatibilities with MaaS (Smith, 2020; Hensher, Ho, Mulley, Nelson, Smith, & Wong, 2020a; Li & Voege, 2017). This emphasizes the need for an adjustment of the governance, for which it needs to be clear in what way MaaS has an impact on the governance (Hirschhorn et al., 2019). To clarify this, significant insights are needed into the challenges and implications MaaS poses for governance, the way public sector actors react to this and how their responses are shaped (Surakka, Härri, Haahtela, Horila & Michl, 2018). This research will address this research gap by clarifying how the governance is being affected, how public sector actors deal with this, and how MaaS could be governed in the case of Amsterdam.

Additionally, to a lesser extent, this research contributes to the academic literature on sustainable mobility. Governance is specifically seen as a crucial component in the development of sustainable transport, but only a limited amount of research has been done on the role of governance within new sustainable mobility concepts (Hull, 2008). Since MaaS supports and is part of the transition to sustainable transport as a Smart Mobility concept, this research can contribute to the academic literature on this topic.

1.4 Reading guide

After this introductory chapter, the thesis now turns to a more scientific approach to the core concepts used. This will be done in chapter 2, which is the literature review. After this, the methods that were used in this research shall be discussed in chapter three. Following this, the results are presented. This is done in the three consecutive chapters 4, 5 and 6. These results chapters each discuss and answer one sub-question. Afterwards, in chapter 7, the main question will be answered in the conclusion of this research. A reflection and research limitations, theoretical and social implications, and further research recommendations are included in chapter 7 as well. This thesis will then be completed with the references used and the appendices.

2. Literature review

The following literature review will reflect on the contemporary and past academic debate on the key concepts that are of importance for answering the research questions of this thesis. The chapter will begin doing so by describing the concept of MaaS. The second section will take a closer look at the concept of urban political economy as a theoretical approach and the concept of platform urbanism which serves as a lens to understand MaaS. Lastly, the governance of platforms and more specifically MaaS platforms will be elaborated upon. The chapter will then be completed with some concluding notes and the analytical framework.

2.1 MaaS

2.1.1 The basics of MaaS

MaaS as a concept was first proposed in 2006. It however took several years before MaaS gained attention. During the 2014 European Congress on Intelligent Transport Systems in Helsinki, MaaS boosted in recognition. Ever since this boost in recognition, MaaS has become a part of the technology and transport lexicon and is being widely promoted since the concept has caught the interest of regulators, academics, transport operators and other stakeholders in both developed and developing economies (Hensher et al., 2020a).

Since the beginning of MaaS, the concept has been described as "a system, in which a comprehensive range of mobility services are provided to customers by mobility operators" (Heikkilä, 2014, p. 8). Other articles added to this by highlighting that MaaS optimally would be delivered through a single digital interface which enables users then to plan multimodal travelling and payments of all the included mobility services and offers users subscription packages as mobility bundles (Hietanen, 2014). MaaS thus integrates various transport services, which should support users in their journey by offering all the necessary information via one digital platform (Lyons, Hammond & Mackay, 2019). The digital platform then rests on technology and digital infrastructures, and on the capture and analysis of data. In this way, MaaS as a digital platform is believed to change the supply and use of mobility. MaaS does however not create more or different mobility. The basis consists of existing transport and infrastructure. MaaS then integrates the links across these different mobility services that currently exist without synchronization. MaaS aims to redesign the existing mobility system and make it interoperable between different services in order to create more efficiency (Smith, 2020).

With the introduction of MaaS, multiple goals are pursued. MaaS is seen as a silver bullet which can enhance current mobility systems. The main goal is to create a sustainable mobility system that is attractive and easy to access for all possible users wherein the users' needs can be satisfied without the use of privately owned cars (Smith, 2020). Ultimately, complementary services will be tied into this too, which will make MaaS more attractive for users. With this, many cities, regions and countries aim to provoke a modal shift from privately owned motorised vehicles to PT, shared mobility and active mobility (Strömberg, Rexfelt, Karlsson & Sochor, 2016). MaaS is thus promoted as a tool to reduce the dependence and need for private vehicles, reduce transport-related emissions and enhance the mobility systems' reliability (Sochor, Arby, Karlsson & Sarasini, 2018; Hietanen, 2014), to ultimately improve the liveability and attractiveness of cities (Essaidi, Tschödrich, Cordonnier, Duthu & Douglas, 2020). Other goals of MaaS are reducing congestion, creating a public cost-effective mobility scheme, improving accessibility and inclusivity of the mobility system, and improving public health (Smith, 2020). But besides the general objectives MaaS aims to achieve, there are also goals that vary per country and region, as MaaS is a very context-dependent development (Bouton et al., 2017).

Despite the growth of recognition and interest from society in MaaS, there is still no clear and generally applied definition. However, in all the different definitions a number of elements have been defined that characterize MaaS and are therefore indispensable in the development and implementation of MaaS. Jittrapirom et al. (2017) made an overview of the characterizations of MaaS based on existing literature. Table 2.1 shows these characteristics with a description.

Table 2.1 Characteristics of MaaS

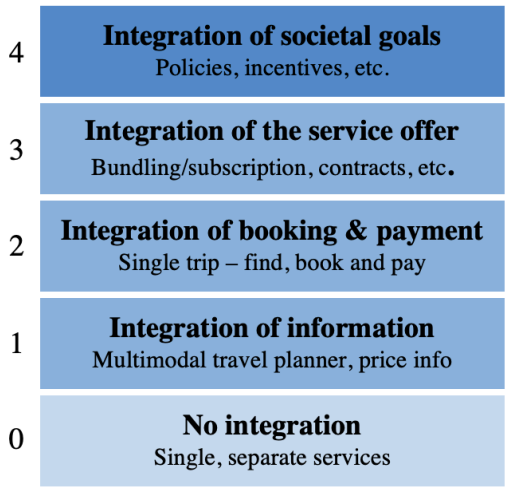
Character	Description
1. Integration of transport modes	A goal of MaaS schemes is to encourage the use of PT services, by bringing together multi-modal transportation and allowing the users to choose and facilitating them in their intermodal trips.
2. Tariff option	MaaS platform offers two types of tariffs in accessing its mobility services. "Mobility packages" which offer bundles of transport modes and amounts of km/minutes based on monthly payments. "Pay-as-you-go" charges its users according to their effective use of the service.
3. One platform	MaaS relies on a digital platform through which the end-users can access all the necessary services for their trips (planning, booking, ticketing, payment, and real-time information).
4. Multiple actors	MaaS ecosystems are built on interactions between different groups of actors through a digital platform to enable the functioning of the service and improve its efficiency. Collaborative actors are amongst other demanders of mobility, a supplier of transport services and platform owners.
5. Use of technologies	Different technologies are combined to enable MaaS: users' devices; a reliable mobile internet network; GPS; e-ticketing and e-payment system; database management system and integrated infrastructure of technologies.
6. Demand orientation	MaaS is a user-centric paradigm. It seeks to offer a transport solution that offers the best fit for customers lifestyles via multimodal trip planning features and inclusion of demand-responsive services, such as taxis.
7. Registration requirement	The end-user is required to join the platform to access available services. An account can be valid for a single individual or, in certain cases, an entire household. The subscription not only facilitates the use of the services but also enables the service personalisation and data collection.
8. Personalisation	Personalisation ensures end users' requirements and expectations are met more effectively and efficiently by considering the uniqueness of each customer. The system provides the end-user with specific recommendations and tailor-made solutions on the basis of her/his profile, expressed preferences, and past behaviours.
9. Customisation	Customisation enables end users to modify the offered service option to achieve their preferred travel experiences. This can increase MaaS' attractiveness amongst travellers and its customers' satisfaction and loyalty.

Source: Jittrapirom et al., 2017, p. 16

Sochor et al. (2018), concur with these characters and clarify that MaaS is user-centred and therefore prioritizes the needs of the users. Maas is capitalizing on this by offering multimodal and seamless mobility instead of individual parallel transport modes. The integration of transport services, information provision, ticketing and payment is the basis for this. Maas is thus a service that depends on the integration of existing elements of the mobility system and digitality. According to Sochor et al. (2018), there are different levels of integration that MaaS can achieve, which are represented in figure 2.1. In this figure, level 0 represents the current level that is predominantly present in many countries and regions. This means that single and separate services coexist, without integration. At level 1, the first integration takes place, that of information. Information is here used to find the best trips, where the multimodality of a trip is not yet taken into account. Level 2 represents the integration of booking and paying for a trip. Here the MaaS operators have a responsibility for purchase processes, the accuracy of bookings and validity of tickets. At the third level, integration of the holistic service offering takes place, where the responsibility of the MaaS operators is extended to include customer support, delay compensations and validation of driver's licenses. The MaaS operators therefore have accountability in

relation to both the users and the mobility providers. At this level, different services are brought together in bundles, possibly through a subscription. Lastly, level 4 concerns the integration of social goals and public values via a governance framework that aims to promote sustainable mobility practices. In order to enable this integration, MaaS will have to be included in policy documents concerning land use, transport, etc., but also by applying and integrating regulatory instruments such as fines, surcharges and active pricing. With this level of integration, new opportunities are seen to implement MaaS and nudge the travel behaviour of users (Sochor et al., 2018; Smith, 2020).

Figure 2.1. the different MaaS levels



Source: Sochor et al., 2018

A higher level of integration does not automatically imply that the system will be better. However, one of the main objectives of MaaS is to transition into a sustainable mobility system. A transition to MaaS can be considered to be sustainable if MaaS will contribute to fulfilling societal goals and public values that are set. To reach these goals, integration level 4 should then be achieved. The overarching point to implement MaaS successfully is that MaaS needs to support societal goals and transport policy objectives (Sochor et al., 2018).

2.1.2 MaaS' ecosystem

The current organisation of mobility systems can be described as a complex detached system in which various transport modes exist in parallel next to each other. Each mobility operator has then its own individual value chains for customers (Tsujimoto et al., 2018). However, to implement MaaS, an integration will be needed wherein all individual providers and other private and public actors will need to operate as a cooperative and interconnected ecosystem (Jittrapirom et al., 2017; EMTA, 2019; König, Eckhardt, Aapaoja, Sochor & Karlsson, 2016). The ecosystem is then a network of organisations and actors, where the boundaries that currently exist between different transport operators will blur or disappear. The ecosystem will then influence how the MaaS providers will create and capture value (König et al., 2016; Arias-Molinares & García-Palomares, 2020).

The ecosystem is for the implementation of MaaS increasingly significant, as the relationships and collaborations of all actors involved serve as the basis for the integration and the digital platform (Jittrapirom et al., 2017; Tsujimoto et al., 2018).

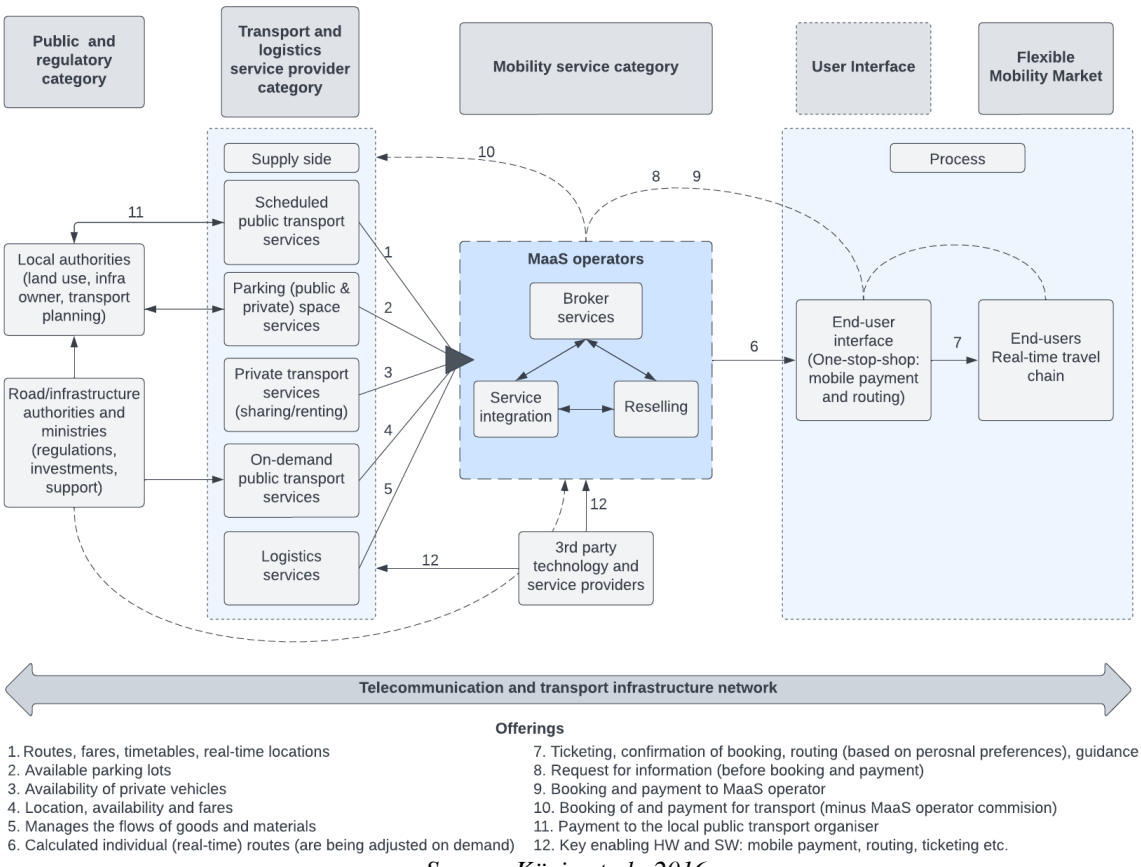
The ecosystem then analyses the networks and all actors in it, whereby an overview exists concerning the roles, responsibilities, and relationships of actors. In the ecosystems, each actor has different purposes, goals and decision-making principles. These differences are deemed important and can cause

unintended results. Therefore, it is important the right relations are built, that there is transparency and collaboration between the actors and that there are common goals formulated where the entire ecosystem works towards (Pulkkinen, Jussila, Partanen, Trotskii, & Laiho, 2019).

In the MaaS ecosystem many different sorts of actors are involved, all with their own goals and ambitions and therefor also with their own responsibilities, roles and tasks. The ecosystem consists of actors which already had a role in the mobility systems, and new actors which fulfil specific MaaS roles. These new actors are the MaaS integrators and MaaS operators, who assemble information and bundle and deliver MaaS offerings to users (Smith, 2020). Besides the MaaS integrators and operators, the actors that are part of the ecosystem are: end users, regulatory organisations, governments, transport authorities, transport operators (both private and public), platform and technology providers, data providers, ICT infrastructure operators, research institutions and media, marketing, advertising, and insurance companies (Arias-Molinares & García-Palomares, 2020; Jittrapirom et al., 2017). However, as MaaS is highly context dependent, the actors which are part of the ecosystem differ per location (Jittrapirom et al., 2017).

The overview of the ecosystem of MaaS can be observed as a network consisting of individually connected actors, all benefitting from their connections to others and the mutual effectiveness. Essentially, the MaaS ecosystem can be classified into four different categories, being the public and regulatory category, the transport and logistics service providers category, the mobility service category, and the end user category, as can be seen in figure 2.2 (larger display in appendix A). This figure shows the categories, the actors belonging to these categories and the relationships that exist between actors (König et al., 2016).

Figure 2.2: Overview MaaS Ecosystem



Source: König et al., 2016

2.1.3 Relations, roles and responsibilities

The MaaS ecosystem builds largely on the existing actors in the mobility system. With the introduction of MaaS, their roles, tasks and responsibilities might change. How they could change is unclear. The MaaS operator is the only new role in the value chain. The role of the MaaS operator can be fulfilled by an existing actor like the regional transport agency, but it is also possible that a new actor will enter the ecosystem to fulfil the role of the MaaS operator (König et al., 2016; Smith, 2020).

And as the ecosystem and the implementation of MaaS rest on the integration of all services and actors, cooperation between all actors is seen as a requirement to make MaaS a reality (Polydoropoulou, Pagoni & Tsirimpa, 2020). The transport authorities and local governments are then believed to have a key position in the ecosystems due to their promotive role in collaboration between stakeholders. The transport authorities and local governments have a focus on societal goals and strongly influence (public) transport operators, which function as the backbone of MaaS. This puts the transport authority and local government in the position to enable or enhance MaaS through various policies and incentives (Arias-Molinares & García-Palomares, 2020; Karlsson et al., 2020). Besides the enabling role for collaboration, the public sector actors also hold a major role as enablers of pilots and as builders of legislative frameworks affecting the potential of different transport modes. The public sector namely has a powerful position in the framework due to their abilities to use legislation and regulation where all actors should obey to. To enable MaaS the focus of the legislation and regulation should be on creating transparent market conditions and a fair market performance and securing true legal positions of users.

2.1.4 Opportunities and challenges

To reach the set goals of MaaS and to enable MaaS in itself, certain challenges and barriers are perceived which can hinder the implementation. These barriers occur in several different aspects, which are explained below.

There are multiple institutional barriers in place that inhibit the development of MaaS and the public-private innovation collaboration between stakeholders (Smith, 2020; Sørensen & Torfing, 2011; Karlsson et al., 2020). Legislation and regulation are herein defined as a prominent challenge since different acts of legislation are perceived to reduce the space for action (Arias-Molinares & García-Palomares, 2020; Smith, 2020). Another barrier regards the multiple public sector actors that are involved in the governance of mobility systems and MaaS. Both private and public actors state that this increases the complexity of the system and hampers the development of MaaS (Arias-Molinares & García-Palomares, 2020; Smith, 2020). But besides solely the public sector actors, also the inter-organisational collaboration with the other actors in the ecosystem is defined as a barrier for developing MaaS. MaaS builds on the collaboration between different types of actors that have not collaborated previously (Karlsson et al., 2020). Often, there then exists a competition based on opposing objectives wherein actors are unwilling to expose their business model, share information and collaborate altogether (Polydoropoulou et al., 2020; Arias-Molinares, & García-Palomares, 2020). These barriers experienced in the collaborations then lead to the question of how to collaborate, as the opposing objectives lead to difficulties in building organisational understanding and trust (Smith, 2020; Karlsson et al., 2020), which asks for transparency and a strong integrator that can operate in a stable and trustworthy way (Ertico, 2019). The collaboration and integration between all actors, but also the reorganisation of actors are thus seen as one of the most important challenges to overcome for implementing MaaS (Arias-Molinares & García-Palomares, 2020; Karlsson et al., 2020; Polydoropoulou et al., 2020).

In MaaS an important challenge is formed by the interoperability regarding the technological advancement and data. Many service systems which need to be integrated are not (yet) fully digitalised. This is why an important technological requirement of MaaS is that services and providers must interface through standardised and open API's (application programming interface) (Polydoropoulou et al., 2020). However, the systems that are digitalised have different data structures and repositories from each other. The exploitation between different sources makes interfacing and communication in this case very difficult. Therefore, ideally, a common language would have to be composed of data standards and API's (Essaidi et al., 2020; Polydoropoulou et al., 2020). Besides these technical designs, MaaS also places high demands on the quality and security of data (Smith, 2020). Here a barrier is formed by data asymmetry, wherein private organisations have more data about mobility systems and users than regulating authorities. Due to competitiveness and a possible lack of trust, the providers might be unwilling to share their data (Polydoropoulou et al., 2020; EMTA, 2019). This puts the public sector actors in a difficult position, as the public authorities need access to high-quality data to facilitate the implementation of MaaS. They need this in order to manage the transport networks and mobility systems, and to enhance their planning capacities (Smith, 2020).

For the current infrastructures and the physical space, a large unknown is how the new services might be competitive or synergetic (Veeneman & Smith, 2016). With the usage of MaaS the fixed routes of PT might decrease in usage and might be replaced by a personalised door-to-door transport service. This comes with challenges for the road capacity, congestion and safety of current infrastructure and urban space, and will affect the development of sustainable urban transportation (Hensher et al., 2020a). Next to this, with MaaS the public space will be commercialised through private transport service providers, which forms a long-term issue for authorities (EMTA, 2019; Hensher et al., 2020a).

2.2 (Urban) political economy and platform urbanism

2.2.1 Theoretical approach of political economy

Political economy [PE] refers to the paradigm that examines how material processes of production, exchange and consumption can shape and are shaped by decisions that are made in economic and political institutions (Urban Political Economy, 2018). PE herein emphasizes the role of capital in politics and in policy making (Keiser, 2017). In this, PE is then a theory that analyses the correlation between the state, markets, and society, which was developed as an approach to understand the emphasis in politics on promoting economic growth (Ribera-Fumaz, 2009).

Within the school of PE, there exists the Urban Political Economy [UPE]. The political economists focussed on the valuation process of capital, but then started to evaluate (the history of) urbanization, concentrating on the hegemony of the urban forms within the social formations. By integrating urbanization into capitalism and the government's attempt to constrain domestic conflicts between social classes, UPE was created (Walton, 1993). The UPE then integrates social and spatial processes and focuses on the material production of and within cities and examines how social life is shaped as a mechanism in the accumulation of wealth, including the power and inequality that results from this (Walton, 1993). The UPE then focuses specifically on the relationship between the 'local state' and the capital. However, this relationship does not exist in a local vacuum, as the behaviour and capital of other cities and nations have strong impacts on this relationship too (Keiser, 2017).
The analysis of UPE centres around the acknowledgement that the urban form and society are both products of socio-spatial relations under capitalism. Capital accumulation is herein reliant on urbanization and the commodification of urban space. Globalization then caused cities to become the main sites of capital accumulation, in which cities act as nodes in networks of global production. And

cities in themselves form physical networks of elements which serve the accumulation of capital (Kębłowski, Lambert & Bassens, 2020; Walton, 1993).

As UPE studied how cities could generate wealth for capitalists, also the question of 'who governs the city' was asked in the debate on community power. The urban governance is namely believed not to be confined to urban governments, and decisions made by private actors are considered equally important in the creation of wealth. This is emphasised in the growth machine theory. This is a territorial defined coalition of urban elites consisting of public, private and civic actors that collectively promote economic growth to advance the common interests where everyone would benefit from (Feagin, 1987). However, in order to realise economic growth and obtain key objectives, the urban space is subject to restructuring. The urban restructuring is not a result of market forces, but of federal interventions and intentional manipulation of powerful actors (Feagin, 1987). The growth machine theory did however not address how urban elites engage with the political realm, how the elites collaborate and how effectively they attract urban growth whilst achieving political hegemony. These matters were taken on by the urban regime theory (Urban Political Economy, 2018). The urban regime theory is a school of urban political science that stems from the PE perspective and influenced UPE. The urban regime theories presume that the efficiency of local governments strongly depends on the collaboration with nongovernmental actors, and the combination of state capacity with the resources of the nongovernmental actors. Urban regimes are then sets of informal and formal arrangements which make urban governance by a public-private coalition possible. Legal authorities can namely not achieve policy changes themselves. The governing capacity is thus created by bringing together a coalition of partners who possess the adequate resources (both material and immaterial), both governmental and nongovernmental (Stone, 1993).

Stehlin, Hodson and McMeekin (2020) mention that the platformisation of mobility like MaaS is the result of the convergence of political-economical and sociotechnical transformations. Spinney (2016) then mentions that mobility is central to productivity, and mobility can enhance capital accumulation and productivity by bringing labour together with capital. The importance of mobility for capital accumulation and for the growth and functioning of cities is herein undisputed (Hodge, 1990).
The infrastructure and platforms then shape capacities for movement. And urban mobility is based on a model in which changes in transportation also lead to changes in the urban forms. The restructuring of urban areas is then also tied to social and economic trends, wherein globalisation and the transition towards a service-oriented economy are the changes that impact local transport and local urban forms the most (Hodge, 1990).

In platform capitalism and the platformised society, and thus also the platformised mobility, data is seen as a form of capital for which accumulation is then organised for the capture and the algorithmic processing. Urban mobility is a fecund data source, where the accumulation of data is dependent on the urban world. Cities are herein nodes which link different infrastructure networks and consumer markets together, and which are thus rich in data that is to be accumulated. The data then serves as capital which can be used to make mobility systems and entire cities more efficient (Stehlin et al., 2020). In this way, the technological capital becomes more deeply entrenched in the PE of cities (Sadowski, 2020).

This theoretical approach offers a way to study MaaS by looking at the coalitions and networks, the capital accumulation, urban restructuring and the influences of political institutions and policy-making. The UPE then provides the opportunity to use the concept of platform urbanism as a research lens to explore MaaS in more detail. The following section will therefore elaborate on the concept of platform urbanism.

2.2.2 Platformisation of society

Cities are finding themselves in the midst of a 'digital turn' in which they are increasingly being affected by the acceleration of the growing influences of digital innovations. Cities are namely subject to digital transformations where technologies are getting intertwined into the urban environments of the city (Barns, 2019). Through the rise of new digital services, the service models and legacy infrastructures of cities are subject to change (Barns, 2018). Nowadays, cities are thus increasingly shaped by the existence of digital platforms. This means that the service provision, patterns of consumption and socializing are being interwoven with the processes of digital platform technologies and datafication (Lee, Mackenzie, Smith & Box, 2020). The emergence of platforms in our society has been described as the 'platform pivot' by Barns (2019). In the 'platformed society', the exchange of information, services and goods is organised through platforms which influence both public and private life through algorithms and data flows (Barns, 2019; Graham, 2020; Richardson, 2020; Bauriedl & Strüver, 2020). Herein are platforms not merely technical entities but they represent a unique socio-technical conception that shapes the urban space and its relations, and it brings implications for the way urban planning is arranged (Barns, 2019; Lee et al., 2020).

The field that is deemed to be most affected by this influence of platforms and digitality is mobility. The role of data and platforms plays an ever-increasing role in the development of mobility in the cities (Lee et al., 2020), and has caused mobility to become platformised (Hodson, Kasmire, McMeekin, Ward & Stehlin, 2021). More specifically, the platformisation of mobility is the result of multiple political-economic and sociotechnical transitions like the unsustainable character of the mobility sector, the development of the geoweb which integrates online content and spatial information, and the rise of the location-based services through the global spread smartphone usage. A result of the platformisation of the city and the mobility sector is MaaS (Hodson et al., 2021). MaaS being a digital platform, can then be viewed through the lens of 'platform urbanism', as MaaS is part of the platform pivot and platformed society.

The infrastructural presence of the platforms such as MaaS in cities has namely marked the rise of 'platform urbanism', which refers to the use and implementation of digital platforms and complex digital infrastructures that shape the informational infrastructure of society and the urban built environment (Riemens, Nast, Pelzer & Van den Hurk, 2021; Barns, Cosgrave, Acuto & Mcneill, 2017). This general trend has been identified and recognised in cities, but the impact and implications of this 'platform pivot' are often still unclear (Barns, 2019; Lee et al., 2021).

2.2.3 The basis of Platform urbanism

The concept of Platform Urbanism [PU] is strongly aligned to the concept of 'smart cities' and is suggested to be an emerging mode of the smart city development (Barns, 2018; Hodson et al., 2021). The concept of the smart city is centred around the intersection and integration of urban environments and traditional services, and data technologies for the benefits of businesses and citizens (Lee et al., 2020; Bauriedl & Strüver, 2020). The smart city herein refers to how different data technologies create a 'datafied city', which entails that the urban space is progressively constituted through the processes of data capture and analysis to make networks and services more efficient (Kitchin, 2014; Lee et al., 2020; Bauriedl & Strüver, 2020). MaaS can herein also be seen as part of this, being a digital platform that partly relies on data and technology intersecting with the urban environments (Karlsson et al., 2020).

PU then emerged in response to the need to urbanise algorithmic and data-based business models of platform-based businesses, and to move beyond smart cities and towards the relation between technologies, cities and consumers through platforms, and to explore alternatives to the traditional 'one

size fits all' approaches in governance in cities (Caprotti, Chang & Joss, 2022). PU is herein seen as the entwinement of the urban space and platforms (Van den Hurk et al., 2021), as PU is centred around the deepening of the spatial dimension of the platform economy, wherein the platforms and the urban space are co-constituted (Stehlin et al., 2020). Caprotti et al. (2022, p. 4) add to this by defining PU as follows:

> *'Urban development and urban life facilitated by a growing number of digitally enabled, socio-technical assemblages that engender new kinds of social, economic and political intermediations'.*

According to this definition, PU, and MaaS being a part of this, can be understood as data-enabled, networked, contemporary and as intermediation of the urban life. Cities and urban life are herein underpinned by complex ecosystems based on platforms that include both private and public organisations, and its users. The focus of PU is then to utilize existing and new data-centred intermediations to compile and construct actors, relationships, technologies, services and urban systems into different (new) geometries (Caprotti et al., 2022; van der Graaf & Ballon, 2019). Barns et al. (2017) add that a key feature of PU concerns the impulse to convert the urban space into a self-adjusted real time city which uses data as raw material that is being generated by everyday practices after which it is processed and made legible as an object of intervention (Barns et al., 2017; Hodson et al., 2021). The aim of PU is then to introduce technological tools that will enable an open collaboration in the urban ecosystems in which cities' complex challenges are solved through data sharing and collective knowledge (Repette, Sabatini-Marques, Yigitcanlar, Sell & Costa, 2021; Bauriedl & Strüver, 2020; Sadowski, 2020).

Within PU, there is a key role being played by digital platforms. MaaS, being a digital platform, occupies a key position in the mobility systems of cities. Herein are MaaS and other digital platforms seen as digital infrastructures which shape and facilitate (personalised) interactions between providers, intermediaries, users and even physical objects. These interactions are then organised through a systematic collection, processing, circulation and monetization of data. As the platforms are based on personalised interactions and are algorithm-driven, the digital platforms aim to enhance the experience of users and increase the efficiency of services by steering or nudging certain user behaviour (Van den Hurk et al., 2021). With the emergence of PU and specifically MaaS in cities, also the platform ecosystems are affected due to the reshaping of the urban conditions, and the (new) actors and institutions and their relations. The ecosystem gets even more entangled regarding the private and public organisations, users and other actors (van der Graaf & Ballon, 2019; Barns, 2019). It is among others this changing complex ecosystem that implicates certain questions for the governance of the platforms like MaaS (Graham, 2020; Barns, 2019).

Within digital platforms, mobility platforms play an increasing role in cities as the process of platformisation affects the entire mobility sector by introducing a new dimension into conventional planning practices. This causes the division between public and private actors to blur, and arrangements between public and private actors start to shift severely because the relations between the involved parties in the mobility system shift. This happens because with the introduction of new actors the organisational dynamics start to shift. The new actors then change dynamics without taking responsibility for the consequences (Van den Hurk et al., 2021). Mainly now that many cities are becoming denser, mobility platforms like MaaS are introduced to change the way mobility systems operate and improve the efficiency of mobility systems and life quality (Riemens et al., 2021; Docherty et al., 2018).

To clarify what PU entails and how it differentiates itself from similar concepts, Caprotti et al. (2022) have created an overview to explain how PU operates in different aspects. This overview can be seen in table 2.2.

Table 2.2: Overview of how PU operates on different dimensions

Dimensions	**Platform urbanism**
Area of focus	The platform infrastructures rely on dense assemblages: large number of providers, users, and technology firms. Typically, a platform is constructed to be scalable to any, or multiple, urban environments. The key focus of PU is any city.
Rationale	Platform operator perspective: to offer an attractive, digitally enabled interface between consumers and service producers, which can be layered upon, embedded in, and applied across multiple urban contexts. To offer opportunity for investment and stakeholder returns, based on a scalable business model. Platform user perspective: to obtain/consume services through an integrated portal and in prompt, convenient fashion, and to engage in complementary social interactions.
Spatiality	Porous and extendable: the platform is territorially defined by the interaction between service providers and users, plus the availability of the underlying technological system. As such it is characterised by geographical and temporal flexibility and fluidity, in turn influenced by urban density. From a user perspective, the platform can be used across different cities.
Temporality	Contemporaneous, short-term, instantaneous. The focus is on day-to-day services and interactions, which change and evolve based on market forces. However, platforms draw and rely upon long-term and permanent infrastructures, built environments and technologies.
Governance	Governance is based on legal contracts/relationships: partnership agreements with providers, owners, workers'; as well as users/consumers (who agree to 'terms and conditions' of use). City authorities often become involved as regulators.
Technology	Digital technology and data analytics are platform backbones. Real-time data, collected from 'partners' and 'users', using a platform-specific app, is analysed to connect partners and users in the most optimal configurations. The platform provider's technology infrastructure may be located a long distance away from the platform's day-to-day urban application.

Source: Caprotti et al., 2022, p. 3

Besides the overview of how PU operates, Caprotti et al. (2022) have as well identified certain elements that characterise PU and mobility platforms, which are the following;

- PU is based on the integration of diverse data flows into different specific platforms which offer either commercial or governance services. This data integration can be seen as a technological solution to specific problems in cities.
- PU is applicable on city- and inter-city scales. The technologies that make PU useful can be sensitive to local context and therefore be adjusted to different urban centres, territories and/or political jurisdictions.
- PU uses data as a resource for datafication of economies and urban management. The platforms rely on data, algorithms, and analytics. The central role of the data in the functioning of urban platforms is related to the functioning of platforms in the era of platform capitalism. The capture and integration of data is thus essential for providing services and goods.
- PU involves the agency of public, corporate, and public-corporate actor networks which can use, develop, and extend the range of platforms. These actor networks are not confined to cities but transcend specific cities or urban centres. Meanwhile, the hybrid networks that are characterizing for PU are severely dynamic and involve a complex ecosystem of actors that continuously changes across time and space.

- PU has a strong spatial component, as the platforms exist in differing urban, political, and economic-regulatory contexts across different boundaries. However, the platforms are located in explicit urban realities, often at city levels. The technology behind the platforms enables the platforms to abstract themselves from space, but the physical elements make them bound to certain locations. This way platforms function across space but are actually rooted in place.
- PU is highly material, as the economic activities that are enabled trough PU are rooted in materiality. While data, codes, servers, and other digital elements are critical to the operation and functioning of the platforms, there are widespread infrastructural networks that enable the existence of the platforms. And while these infrastructure networks are not always visible, they are crucial in the connection of physical goods and services to the digital online representations.

2.2.4 Implications of platform urbanism for cities

It has been made clear by Riemens et al. (2021), van der Graaf and Ballon (2019), Barns (2019) and Graham (2020) that through PU and a platformised society, our society and way of living will be affected. However, it is important to also pay attention to the implications PU and MaaS bring with it and acknowledge the challenges which are revealed by the nuances of the platformised society and the 'platform pivot' (Lee et al., 2020). Many of the experienced challenges and implications of PU and MaaS cover several societal aspects, but in this section the implications will be discussed under the categories of data, urban space and regulations and public values as these are the areas where the main challenges and implications are situated.

Data

With the introduction of platforms into society, data has taken on a larger and more pivotal role in society. To ensure that the platforms serve the foreseen goals and solve complex problems in cities, technological tools are deployed based on sharing data and collective knowledge in an open way in the complex ecosystem. For the data to be open, it must be considered as a collective asset, so all actors can use and share collected data (Repette et al., 2021). Due to PU and the platformisation of society, the millions of transactions and interactions that occur every day in cities are generating massive amounts of data. This amount keeps growing and is of increasing value to private and public actors who want to apply data-driven methodologies in order to improve the efficiency and the quality of the services in cities (Barns, 2018). By collecting, analysing, and sharing this information and data, there is great potential to revitalise and transform the governance of cities. And due to the growing amount of data that is created every day, more and more data-driven tools come to existence, designed to make urban services more responsive and address the challenges cities deal with (Barns, 2018; Goldsmith & Crawford, 2014). However, an implication that plays here, concerns the position of private actors and platforms. The private actors and platforms namely have a strong market position which they want to preserve, as this brings a market advantage for them. They receive data from users, and demand secrecy to preserve their market advantage and to accomplish their profit motives (Hodson et al., 2021; Fields, Bissell & Macrorie, 2020). These agendas of private parties leave (local) governments with limited capacity to access and use the large amounts of data themselves, as this is held by the private actors (Barns et al., 2017). As long as the data remains privatised by private actors, the democratic governance of the planning is expected to erode (Hodson et al., 2021). There is also the risk that if a significant fraction of the data is in the possession of private actors, public interests and values cannot be optimally pursued since the private actors do often not prioritize public values (Lee et al., 2020). Public actors like governments should therefore play a more active role in managing the cities data assets if they want to develop and use the data driven tools and the services in order to address the challenges cities deal with (Barns, 2018).

As the role of data in platformisation is larger than in previous developments, there remain questions unanswered about who will own, control and share the data, while ensuring that public values like inclusivity, diversity and privacy are taken into account. Herein it is also unclear how roles and responsibilities will be divided in the ecosystem (Van der Graaf & Ballon, 2019). Furthermore, it is unclear how public data will be used in planning. It is important to know how data will be deployed, monetised and stored in order to realize the anticipated benefits (Barns et al., 2017)

Urban space

As PU is seen as the integration of platforms and urban space, it is impossible to ignore the relationship between the two (Van den Hurk et al., 2021; Fields et al., 2020). The relation between platforms and urban space was long seen as a hybrid relationship that is impossible to disentangle. Due to this entanglement and the growth of platformization, the platforms continuously and re-iteratively create new forms of the urban space. The technical developments have namely caused actors to collect and analyse data which is then used to manage and control urban environments and cities. And the everyday usage of urban space is being altered by the use of digital devices such as smartphone apps or electronic public screens (Fields et al., 2020; Dodge & Kitchin, 2005; Rose, 2017). Furthermore, platforms are thus increasingly meddling with the existing urban environment and infrastructures, which leads to transformations in the existing urban infrastructures. The infrastructures are being platformed, and with this are public utilities being splintered into private services which are controlled by private organisations with private interests (Lee et al., 2020). The transformation that the urban space is going through due to the platformization, is underpinned by a complex and also blurred platform ecosystem. But as the platforms provide services (partly) controlled by private interests and are not value-free, the way people experience and perceive the urban space is affected. This has consequences for the behaviour of people in the urban environment, which is the base of the changing politics of the urban space (van der Graaf & Ballon, 2019; Ramirez, 2016).

Lastly, an issue that is experienced in the platformisation of society relates to mobility platforms more specifically. These platforms namely produce new mobility scales that both implode and also explode urban space, depending on the articulation with the existing infrastructural scales. Micro-mobility platforms for example focus on the markets with high demand which are typically located in the central business districts and gentrifying areas. This causes the infrastructural scale to collapse inwards, and places that lie beyond the target areas will typically be cut from transport services. However, ride-hailing services oppositely explode the scale of mobility outwards. The smartphone basis namely enables customers and drivers to access areas that are less centrally located (Hodson et al., 2021). There still remains unclarity about how the inclusivity and accessibility of the platform networks in cities will be accomplished. As these objectives are essential for the quality of the city, public actors should engage in order to ensure those public interests. If they are not active enough, the risk arises that the platforms will not be inclusive, accessible or covering for its service area (Barns et al., 2017; van der Graaf & Ballon, 2019).

Regulations and public value

In the concept of PU and with the platformisation of society, a focal point concerns the control that is to be exerted over the platforms that are implemented in society. PU namely induces implications for the regulation of several aspects of society, like mobility. The platforms cannot simply be ‘plugged in’. To ensure that platforms are compatible with existing systems, safeguard public values and operate efficiently, rules and frameworks are established (Van den Hurk et al., 2021). However, an implication according to Graham (2020; p 453) is that platforms are presented as ‘too new to regulate, too big to

control and too innovative to stifle'. Besides, platforms remain distant and undemocratic, and have themselves no interest in safeguarding public values or invest in local priorities, which causes severe struggles for cities to organize PU. These public values then include safety, privacy and security, but often pertain to broader societal effects such as accessibility, sustainability, inclusivity, democratic control and fairness. And values as such are at stake in the platformisation of society (Riemens et al., 2021). The discussion about the prioritisation of public values is thus of utmost importance for the implementation of platforms into society. If the public values that are being pursued are not coordinated amongst public and private actors, conflicts can arise that complicate implementation. Ensuring, safeguarding and enhancing public value is therefore a key governance aim in the platform pivot. The changing network of actors, power and resources, the new services and how mobility is regulated and priced all require to be negotiated if the implementation of mobility platforms wants to capture the public values (Docherty et al., 2018). In complex multi-actor constellations, the actors should then firstly define the essential public values. Following this, all actors should accept their responsibility and role in the safeguarding of these values. In this it is key to find the balanced level of regulation whereby private actors can participate and innovate, and where the public interest is served (Karlsson et al., 2020). The state bears herein the primary responsibility to act as guarantor of the public values and use their rules and regulation to do so (Docherty et al., 2018).

Digital platforms and technologies thus introduce new dimensions to the conventional planning practices as they are known. Besides, they also affect the overall governance of the existing planning practices and present new challenges in planning due to the shift and new constellations of ecosystems and the lack of control and transparency (Van den Hurk et al., 2021; Docherty et al., 2018). The new urban practices PU brings and how to efficiently manage these has a strong governance component (Hodson et al., 2021). And the challenges MaaS and PU bring, demand a new strategic approach to the governance of mobility. It could even be stated that a new governance model is needed in order to implement MaaS (TNO, 2020). How the platforms, and more specifically MaaS platforms will challenge and affect the governance, and what a possible new governance model entails, will be elaborated upon in the upcoming paragraph.

2.3 Governance of MaaS platforms

The identified challenges of MaaS and platforms imply that realising MaaS platforms will require interventions from both private and public actors on varying institutional scales. This poses great governance challenges and demands a new strategic approach on how to govern MaaS platforms if MaaS platforms are to contribute to the set objectives (Hensher, Ho, Mulley, Nelson, Smith, & Wong, 2020b). According to Van der Heijden (2014), governance is defined as an intended activity that is undertaken by one or multiple actors which seek to regulate and shape behaviour to achieve desired collective goals (Fenton et al., 2020).

The introduction of platforms into our society and the implications that this entails, change the cities, which require the organisational frameworks and governance models to evolve (Barns, 2018; Arup, 2014). Through platformisation, the goal is that service provision and life quality in cities will improve. The platformisation and foreseen goals can however not simply be realised by investing in digital platforms and technology solutions alone. The platformisation requires a 'reinvention of governance' which includes transforming the manner all authorities collaborate internally, with private actors and citizens (Barns, 2018). The traditional governance paradigms - where the government is the central player - are not usable anymore for initiatives enabled through technology and data wherein complex societal problems are solved by digitally connected actors in collaboration with governments and

authorities, as is the case with PU and MaaS platforms (Repette et al., 2021). PU is in this way responsible for changing the governance in a disruptive manner. But in what way the governance should change so that PU can be properly guided, is still unclear (Repette et al., 2021; Gil, Cortés-Cediel & Cantador, 2021).

2.3.1 Governance: How to govern MaaS platforms

MaaS brings on a paradigm shift of great impact. This transition will thus intersect with the governance of current mobility and causes challenges like data asymmetry, the redistribution of public space to commercial purposes, the endangerment of public values, monopolistic schemes, and the spatial uptake of MaaS and splintered spatial distribution of shared mobility (Pangbourne et al., 2020; EMTA, 2019). The transition and the posed challenges require the governance of mobility systems to adapt (EMTA, 2019). The adaptation of the governance will require strong input from the state and society. Without the state's involvement, it is unlikely that the existing systems can be replaced. To optimize the contributions of MaaS platforms to the greatest extent possible, the platforms should be integrated into the larger urban agendas and strategic urban plans and visions (Pangbourne et al., 2020; Van den Hurk et al., 2021). In order to change the existing systems and include MaaS platforms in city plans, policies will need to be adjusted in order to change the economic frame conditions such as regulation, legislation, subsidies and taxes. The management of the paradigm transition is herein depending on the adaptive capacity of the current systems' governance to adapt to the changing circumstances (Docherty et al., 2018).

With the introduction of MaaS platforms, some new organisational aspects are presented which ask for new governance approaches. These new aspects are the data and system integration, the service provision, and the platform as a network which has a complex ecosystem. These aspects do not exist yet in current transport systems, which is operator focused instead of customer-focused and where transport operates individually (Pangbourne et al., 2020; EMTA, 2019).

Data is a new concept within MaaS platforms that was not previously part of the governance of mobility systems. But data is in the new mobility system the most valuable commodity since it brings structure that matches the demand to mobility. Data is thus the knowledge upon which the power is based to control the ecosystem and the market. Because of its prominent role in MaaS, there should be deep discussions about the roles of actors regarding data as all actors have personal interests in a position where they have access to the data (Docherty et al., 2018). The creation of public-private data collaborations is herein seen as an opportunity to improve the way cities are being managed by adopting collaborative governance models to support strategic goals. With data collaborations, the aim is then to generate sustainable data partnerships concerning specific challenges. This could then contribute to the realisation of policy goals and priorities (Barns, 2019). But as of right now, data poses a challenge for governments in managing the city. With the rapid growth and influence of proprietary urban platforms, new data has been enclosed. Because of the rise of commercial actors in the ecosystem, these data are however not freely accessible to governments as the private actors do not voluntarily share data due to commercial reasons or privacy protection. But to achieve urban policy goals and safeguard public values, governments need access to necessary data resources. In order to support the platform's services, monitor the operations of platforms, and address challenges, governments need to play a more active role in the management of data assets (Barns, 2019).

However, the development and implementation of MaaS platforms is not merely a technological challenge. Another prominent challenge for the new way of governing mobility is related to the dynamic

and complex composition of actors and institutions that continuously interact with each other (Fenton et al., 2020). With the platformisation of MaaS new actors join the ecosystem, relationships between actors change and roles and responsibilities change as well (Repette et al., 2021; Riemens et al., 2021). The actors in the ecosystems often have conflicting goals. The public actors aim to safeguard public interest and create inclusive and comprehensive services. Private actors, however, have contrasting visions and aim for individual and often profit-related objectives. These contrasting objectives can create conflicting interests in the ecosystem which can endanger the implementation of platforms (Riemens et al., 2021). But in the development and implementation of platforms, the public actors require the support of private actors and vice versa. Without each other, it will be impossible to realize MaaS platforms in society (Lee et al., 2020). This is why for governing MaaS platforms there must be a focus on collaborative governance models (Repette et al., 2021*)*. It is important that the actors acknowledge the value of collaborating based on shared values (Fenton et al., 2020) since public-private partnerships, legitimacy and regulations are essential for developing MaaS platforms.

As of now, there is a lack of evidence indicating how mobility systems and their governance will exactly change. This is partly because of the context dependency of the development of MaaS platforms. The governance arrangement is namely dependent on the organisational culture that is present in the concerning city, region, and country (Lee et al., 2020).

2.3.2 Governance models

It has been made clear that MaaS platforms will require a new way of governing the mobility system. While the current governance paradigm is no longer deemed appropriate for governing the platformised society, there is no single 'one size fits all' approach that indicates how the governance model needs to change since the design of the new governance models will be dependent on technological maturity of governments, the organisational structures, available resources, and the participation cultures (Hensher, Ho, Mulley, Nelson, Smith, & Wong, 2020c; Repette et al., 2021). However, Smith (2020) has mentioned that the collaboration between all actors will be a significant component in developing a new governance strategy. Collaborative innovation could offer insights in this. Collaborative innovation essentially is an innovation process through which a plurality of public and private sector actors work together to innovate (Sørensen & Torfing, 2016; Smith, 2020). The inter-organisational collaboration offers an opportunity to strengthen the innovation process while focussing on the safeguarding of public value instead of commercially generating revenue. Additionally, collaborative innovation clarifies that public innovation is not driven by public or private actors, but it integrates a range of different actors, both public and private, to work on solutions in an integral manner (Smith, 2020). According to Hensher et al. (2020b), collaborative models are needed for the building of understanding, trust, and transparency in the development of MaaS platforms. This will create opportunities for long-term collaborations based on shared values across both public and private actors. (Hensher et al., 2020c).

The new way of governing the mobility system could according to Smith, Sochor and Karlsson (2018b) and Arias-Molinares and García-Palomares (2020) be arranged in three different scenarios: the market driven development, the public controlled development, and the public-private development.

- In the market driven scenario, the role of the MaaS integrator and MaaS operator are taken on by a new or incumbent private actor. The private actors are believed to have better capabilities and higher incentives to develop MaaS compared to the public actors. The private actors are then responsible for enabling MaaS, while the role of the PT authorities would not change regarding their role in the current mobility system, and thus would the public sector be the PT provider.

- The public controlled scenario implies an enlarged scope for the PT authorities. Their responsibility of planning the PT would be widened with adopting the roles of MaaS integrator and MaaS operator. Public actors would be responsible for the funding, implementation, and the operation of MaaS. But public actors could also source this responsibility out to a private or new actor, over which the public actors would then have direct or indirect control. This scenario gives public actors the power to steer the development towards public values and societal goals.
- The public-private scenario is essentially the middle way. It implies that both public and private actors take active roles in the development and implementation of MaaS. The public actors would take on the MaaS integrator role, and the private actors would absorb the MaaS operator role.

The general rule that can be applied to these different scenarios is that too much regulation can impede the ability of the private actors to innovate and participate which makes MaaS platforms unattractive, but too little regulation can lead to negligence of the public interest (Arias-Molinares, & García-Palomares, 2020; Smith et al., 2018a).

2.3.3 Public sector in governance

The transition towards MaaS platforms requires second thoughts on the responsibilities and roles of public authorities in governing mobility. Docherty et al., (2018) and Van den Hurk et al. (2021) mention it is not a question if the governments should play a role in the development and implementation of MaaS platforms, but what role they must absorb. It is necessary that authorities comprehend what the governance of MaaS platforms should look like and what the role is for public actors to mobilise opportunities, regulate harmful impacts and safeguard public values (Docherty et al., 2018).

In previous sections it has been mentioned that a collaborative approach is required for developing and implementing MaaS platforms. The question herein remains what the role of the public actors, and most specifically the local and regional governmental actors, should be (Fenton et al., 2020). Public actors can absorb different roles, passive or active. The governments can then choose to take more control and closely steer the development by regulations and restrictions, or to coordinate and let the market and private actors develop freely (Smith, 2020; Sørensen & Torfing, 2016; Sørensen & Torfing, 2011).
The governmental actors can thus take on different roles and use different instruments to intervene in MaaS platforms and the ecosystems to achieve goals by using various steering tools and by interacting with other actors (Hirschhorn et al., 2019; Sørensen & Torfing, 2009). The extent of intervention and involvement then differs based on what role the government takes on and how actively they are involved. Depending on how involved they are in the development process, the governments are decisive for the design and herein restrict the free operation of the market (Sørensen & Torfing, 2009).

The governmental actors have an important role in establishing appropriate regulations and policy frameworks needed to implement MaaS platforms and in order to facilitate the data-driven services that are in line with the city's priorities (Barns, 2018). Additionally, Van den Hurk et al. (2021) and Davis (2018) mention that governmental actors should take on a more proactive role in the governance by firstly acknowledging the digital dimension of MaaS platforms in urban planning and the increasing role of data and algorithms that shape urban life. They should then also reshape the tasks and responsibilities of other actors in order to safeguard and encourage public values.

2.4 Concluding notes and analytical framework

This literature was structured into three parts, which each discussed a concept of importance for this research. The first section herein looked to the concept that is central in this research, namely that of

MaaS, in which the characterisations, the ecosystem and the challenges where discussed. The second section of this chapter then disclosed the theoretical approach of UPE and the concept of PU which serves as a lens of UPE. PU offers a perspective that can be used to look at the concept of MaaS. In this second section the characterizations, the role of platforms in society, and the implications of PU for cities were described. As this research looks at the way governance is being affected by MaaS, the third section focused on the effects of MaaS on governance, how to govern MaaS and PU, and what possible governance models exist for governing these concepts.

In this literature review, it has then been made clear that MaaS, being a platform, introduces new characteristics into the mobility system that changes the mobility provision for cities. Besides, it was made apparent that this causes the governance of the mobility systems to have to adapt in order to develop and implement MaaS successfully. However, in what way the governance should change to make sure the development and implementation can be properly guided, and municipal goals can be achieved, remains unclear. This led to the following research question:

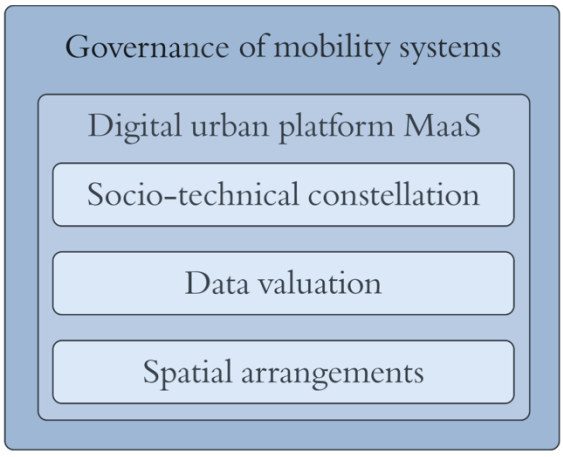
What does MaaS mean for the governance of Amsterdam's mobility system?

In order to answer this research question the following sub-questions have been formed:

1) Why is MaaS of interest to the city of Amsterdam and what are the municipal goals for MaaS in Amsterdam?
2) What is distinctive about MaaS processes and what do they mean for provision of mobility?
    a) What is the socio-technical constellation of Amsterdam's MaaS?
    b) What is the role of data in creating value for Amsterdam's MaaS?
    c) How is the Amsterdam MaaS platform co-constituted with urban space?
3) Given these characteristics, how could municipalities govern MaaS to ensure public value & equitable access to mobility*?*

These questions result in the creation of the conceptual framework below in figure 2.3. This figure shows how the concepts from this thesis are related and will be researched.

Figure 2.3: analytical framework



Source: author

The theoretical approach in this research is then UPE, and the concept of PU is herein used as a lens in order to understand MaaS. In the article of Caprotti et al., (2022) on PU then attention has been given to how digital platforms like MaaS operate on certain dimensions of society and what characterizes these

platforms. This chapter then further elaborated on the governance implications of MaaS, in which this research examines how these affect the mobility system and how the city of Amsterdam could or should adjust its governance. Herein can most of the key dimensions be categorised into the three categories of the socio-technical constellation, the data, and spatial arrangements.

- The socio-technical constellation herein relates to the aspects of the network of platforms. Platforms are namely characterised by networks, which consist of a certain complex multi-actor ecosystem, material and digital infrastructures, and material and digital components such as the digital interface.
- The data then relates to the technology and data analytics that serve as the backbones of the platforms, which relies on integration and interoperability. Herein is the data deemed essential for the provision of services and goods, and for offering the technical solution to problems experienced in cities. The data is herein a highly valued component of platforms, which can be seen as a source of knowledge.
- The spatial arrangement relates to the physical space and the public values that are connected to this. The platforms are geographically and temporally flexible and fluid, but the platforms are located in specific urban realities wherein the physical elements make them bound to those specific locations. Herein are the platforms of influence on the development of physical space, and vice versa. This is of importance for the creation of inclusivity, accessibility and safety in the use of the platform.

The framework, the theoretical approach and the lens can then thus be used to identify how these characterizing elements of platforms affect the governance of mobility systems, by specifically looking at the case study of Amsterdam. This framework then offers a manner to understand the concept of MaaS better. By doing so, the research connects the concept of MaaS, through the theory on UPE and the lens on PU, with the concept of governance.

3. Methodology

This methodology chapter will set out the methodologies that are central to this research. This chapter is divided into 4 sections. Firstly, the motivation for the selected research strategy and design and the case study of Amsterdam will be explained. Secondly, the methods used for data generation will be discussed. Following this, the preparing and analysing of the generated data will be elucidated. And lastly, the research quality will be reviewed.

3.1 Research strategy and research design

3.1.1 Research Strategy

The methods used in research are tied to different visions of how reality should and could be studied. The methods used then relate to how the relationship is seen between worldviews about the construction of reality and how this should be studied (Bryman, 2012).

The ontology of research is related to the way entities and social phenomena are understood, which differs per person. How one sees phenomena then influences the research process. This study has a social constructivist ontology. This entails that the phenomena that are researched are continuously in a state of revision and construction, and are continuously being shaped by social actors (Bryman, 2012). This complies with the challenge of the development and implementation of MaaS, and how MaaS affects the governance of mobility systems, as there is not an undisputed, scientifically proven governance strategy and definitive social reality due to its context and actor dependency.

Epistemology is then concerned with the mind's relation to reality and is known as the theory of knowledge. According to Bryman (2012), epistemology then sets out the beliefs about how knowledge about reality is discovered. In line with the social constructionist ontology, this research will take on an interpretive epistemological approach which assumes that the world is constructed through one's own interactions, interpretations, and experiences of phenomena. This research is placed in the interpretive tradition, as the knowledge about reality on MaaS is subjective and constructed. MaaS is namely highly context-dependent. And since the context is severely different per city, and there is no 'one-size-fits-all' governance strategy, the 'truth' about how to govern MaaS is different per city or country.

The constructionistic ontology and the interpretive epistemology that are central to this research both result in the use of a qualitative research strategy (Bryman, 2012). Through the use of qualitative methods, insights can be obtained into the perspectives, experiences, valuations and stories of people, and the ways in which these are socio-institutionally structured. The aim of this research is to provide in-depth insights and knowledge on the governance change that MaaS causes for Amsterdam on multiple aspects, and the challenges that are posed for the governance. As MaaS and its governance are still new and innovative with few practical applications and is highly context-dependent, it is important that the specific situation and experiences are being truly understood. To create the needed depth and detail for understanding the governance changes in the context of MaaS as a social problem, and to create understanding of the situation, qualitative research methods are believed to be the most suitable to research MaaS (Polydoropoulou et al., 2020; Ruddin, 2006; Bryman, 2012). This is why several qualitative research methods were combined in this research, being a document analysis, stakeholder workshops, and interviews.

3.1.2 Research design

The research design deemed the most suitable for achieving the aim to create in-depth knowledge on the governance change in Amsterdam is that of a singular case study. The case study design allows a researcher to investigate a single case intensively, which is essential to this research (Bryman, 2012; Flyvbjerg, 2006). The single case study lends itself to depicting complex processes and specific elements

that are difficult to extract from context, and it provides the opportunity to render descriptions (Yin, 2013; Gustafsson, 2017; Flyvbjerg, 2006).

Amsterdam was specifically selected as a case study since the pressure on mobility in Amsterdam is increasing, and to accompany this growth, investments are being made in new traffic networks in Amsterdam (Provincie Noord Holland, 2018). In this context, Amsterdam closely follows international developments in which a collaboration has been established to exchange scientific and practical information between various cities (Gemeente Amsterdam, 2019). Amsterdam is also a leading tech hub in Europe, which makes it a suitable location for the development of smart technology and its specific application to mobility (Provincie Noord Holland, 2018), since digitalisation plays an important role in the creation of MaaS (Gemeente Amsterdam, 2019).
As a metropolitan region, Amsterdam is ambitious to apply MaaS on a large scale. Therefore, various MaaS pilots and initiatives have been launched to experiment with the concept (VRA, 2021). By experimenting before later implementation, the ideal breeding ground for these innovations in the mobility system exists in Amsterdam (Kennisinstituut voor Mobiliteitsbeleid, 2019). In addition, there are various (commercial) parties and platforms that see opportunities in offering MaaS in Amsterdam, and their presence is conducive to the wider development of MaaS (Gemeente Amsterdam, 2019; Kennisinstituut voor Mobiliteitsbeleid, 2019). Amsterdam is currently thus in the developmental phase of MaaS activities and is seen as a suitable location for adopting MaaS (Hirschhorn et al., 2019).

3.2 Research methods

3.2.1 Document analysis

The first qualitative research method applied in this research is the document analysis. In the case of document analysis, different documents are critically scanned on certain selected topics that are relevant to the research in a structured way (Bryman, 2012). By reading and scanning the documents systematically, observations are made to gain understanding and develop empirical knowledge (Wester 2006, p. 16; Bowen, 2009).

Since the research on the governance of MaaS is highly context-dependent, the document analysis outlined the situation and provided the context-dependent knowledge that was required to understand this case and perform further research to answer the research questions. This created the basis for the single case study (Audouin & Finger, 2018; Bowen, 2009). For the document analysis multiple documents were used, which are indicated in table 3.1.

Table 3.1: overview of all policies and visions consulted for the document analysis

	Document	Organisation	Description	Reason for selection
1	Strategie Mobility as a Service	Municipality of Amsterdam	Strategy Mobility as a Service	Outlines the possible strategies for the development and implementation of MaaS after the pilots/learning phase
2	MaaS aan de Amstel	Municipality of Amsterdam	Manifesto for an Inclusive Mobility System	Outlines how MaaS can contribute to an inclusive mobility system
3	Hubsvisie Amsterdam	Municipality of Amsterdam	Vision on physical mobility hubs in Amsterdam	Outlines the strategy of the development, financing, and governance of physical mobility hubs
4	Visie MaaS VRA	Regional Transport Authority Amsterdam	Vision on MaaS for the region of Amsterdam	Outlines the goals, chances, and governance strategies of MaaS for Amsterdam
5	Leidraad Gebiedsontwikkeling	Metropolitan Region Amsterdam	Roadmap on area development and smart	Outlines the integration of spatial developments and smart mobility, by

	& Smart Mobility		mobility in region Amsterdam	describing context, and different tools for mobility development
6	MaaS-pilots Optimaliseren van het mobiliteitssysteem	Ministry of Infrastructure and Water Management	Description of the MaaS pilots in the Netherlands	Outlines the goals and content of the 7 nationally coordinated MaaS pilots
7	Naar een gebalanceerd integraal mobiliteitsecosysteem Mobility as a Service: de Nederlandse aanpak	Ministry of Infrastructure and Water Management	The Dutch strategy towards a balanced and integrated mobility ecosystem for MaaS	Outlines MaaS in the perspective of the mobility transition, and the role of data in MaaS. Also describes the Dutch MaaS program and the learning environment
8	Mobility- as-a-Service: kansen en verwachtingen	Netherlands Institute for Transport Policy Analysis	The chances and expectations of Mobility as a Service	Outlines the societal impact of MaaS
9	Mobility as a Service onder de loep	Netherlands Institute for Transport Policy Analysis	A research report regarding the vision of experts on MaaS	Outlines the added value of MaaS for society and the potential of MaaS for regions and (specific) users
10	Meer zicht op Mobility as a Service	Netherlands Institute for Transport Policy Analysis	More insight into the effects of MaaS	Outlines the preconditions for the development and the added values of MaaS
11	Policy options to steer mobility as a service: international case studies	TNO	An independent, comparative case study on the governance of Mobility as a Service	Outlines the context and analyses of different cases of practical MaaS implementation through a governance framework
12	Mobility as a Service Bouwstenen voor keuzen I&M	Mu Consult	Building blocks for choices about MaaS for the ministry	Outlines the realization of policy goals for the ministry regarding MaaS, and the organisation of MaaS
13	De toekomst van MaaS	Capgemini	The future of MaaS and the MaaS models	Outlines an analysis of various MaaS models and related challenges, and a specific contextual analysis on The Netherlands

The document analysis allows different research methods of data gathering to be combined with another as a means of triangulation (Yin, 2013; Bowen, 2009). This is why the use of the document analysis is suitable to combine with the case study. The basis of the document analysis was therefore also used for further steps in the research (Knopf, 2006). The findings from this document analysis consequently functioned as foundation for understanding and optimizing the stakeholder workshops, and for the design of the interview guides for the interviews.

3.2.2 Stakeholder workshops

The second method that was applied to answer the research question and sub-questions concerned stakeholder workshops. Stakeholder workshops relate to complex social ideas which spread through varying domains at various complexity levels like policy making, societal changes and technology and innovation (Ørngreen & Levinsen, 2017). Originally, workshops were developed to generate new ideas and to find new solutions to social problems (Alminde & Warming, 2019). This is done by evaluating certain aspects that are of interest which leads to the production of new output in regard to innovative ideas, such as MaaS (Thoring, Mueller & Badke-Schaub, 2020). The stakeholder workshops were then arrangements where people collectively obtained new knowledge or innovated regarding specific issues (Ørngreen & Levinsen, 2017).

Stakeholder workshops can be applied as research method to specifically acquire more in-depth knowledge about MaaS (Polydoropoulou et al., 2020). Through the organisation of stakeholder workshops, a type of data was then generated which differed from all other research methods, creating the opportunity to generate more depth, and to gain more knowledge that could not be generated through other methods (Ørngreen & Levinsen, 2017).

During the research period, two stakeholder workshops were organised and have been conducted. Another two workshops have taken place outside the timeframe of this research and could therefore not be included in this research. The workshops were also a part of the internship at the municipality of Amsterdam that was followed in combination with this research. The workshops were initialised by the municipality of Amsterdam to promote an integrated collaboration between several governmental actors and to jointly create a vision of the desired MaaS development in Amsterdam. The workshops, therefore, also functioned as a learning opportunity to gain insights into further development. For this purpose, the workshops were all devoted to a subject related to MaaS that required further discussion. Table 3.2 presents an overview of the workshops.

Table 3.2: overview of workshop

	Workshop theme	**Date**	**Time**
1	MaaS and policy and inclusivity	16-02-2022	12.00 – 17.00
2	MaaS as a platform and data	21-04-2022	12.00 – 17.30
3	MaaS and the physical environment	13-09-2022	12.00 – 17.00
4	Integrating and concluding workshop. Discussion on continuation of the MaaS development and strategy for Amsterdam and the Netherlands.	10-11- 2022	12.00 – 17.00

All the participants of the workshops were representatives of governmental organisations, namely the Municipality of Amsterdam, the Regional Transport Authority of Amsterdam, the Metropolitan Region Amsterdam, and the Ministry of Infrastructure and Water Management. All participants are related to the development of MaaS in the Netherlands and, more specifically, Amsterdam. The total group size differed per workshop but always consisted of 10 to 15 participants. The workshops consisted partly of presentations based on lessons learned, experiences, and general knowledge and partly of answering questions and discussing statements. The participants were encouraged to participate actively through the interactive character of the workshops, through questions and statements, and by having the participants present. The researcher of this thesis was present as an intern, being a member of the delegation of the municipality of Amsterdam. The researcher was herein mainly responsible for producing the reports of the workshops.

3.2.3 Interviews

The last method used for data generation was interviewing. By conducting interviews, the aim was to obtain detailed and rich information that was not readily available in pre-existing documents. Since MaaS as a concept is still very innovative and has few practical applications, there is still a lot of knowledge to be gained about the development and implementation of MaaS and its governance. It was, therefore, important to talk to people who have knowledge of MaaS or are experienced with its development in order to provide sufficient depth to this research. Interviews are then considered a suitable technique to obtain this data (Bryman, 2012).

The interviews had a semi-structured character. This is a form of information gathering where the interviewer has prepared a pre-determined topic list that provides structure for the interviews, and between all the conducted interviews (Creswell & Creswell, 2018; Bryman, 2012). Appendix C shows the interview guide that was used during the interviews. By conducting interviews of a semi-structured

nature, there was also room to digress to other topics when they appeared relevant or to give the interviewee room to elaborate further on their perspectives, experiences, or perceptions (Mason, 2018; Bryman, 2012).

To answer the research questions, nine interviews were conducted. The participants consisted of people working for public and private companies. The participants were mostly working for governmental actors or were consultants. This was done to get the most complete overview possible of the development of MaaS in Amsterdam. The public and private actors namely experience the development differently and encounter different issues. In table 3.3, an overview of the interviews can be found, in which the organisations and functions of each participant can be seen as well, indicating the range of the participants.

Table 3.3: overview of interviewees

	Function interviewee	**Organisation interviewee**	**Date**	**Duration**
1	Strategic project manager Smart & shared mobility I MaaS I Hubs	Municipality of Utrecht	09-06-2022	50 min.
2	Independent consultant working on MaaS	Enigma consulting	10-06-2022	1hr 20 min
3	Consultant Smart Mobility and Urban Systems; Transport researcher	TNO	14-06-2022	1hr
4	MaaS strategist Amsterdam	Municipality Amsterdam	15-06-2022	1h
5	Program manager hubs and smart mobility Amsterdam	Consultant municipality Amsterdam	21-06-2022	50 min.
6	Consultant smart mobility platform MRA	MRA & Rebel group	22-06-2022	55 min.
7	Policy advisor innovative mobility VRA	Regional transport authority	23-06-2022	1h 5 min.
8	Project manager innovation office Amsterdam	Municipality Amsterdam	24-06-2022	55 min.
9	Contract manager MaaS	Municipality Amsterdam	01-07-2022	1h

The interviews were partly conducted face-to-face, and partly online through Microsoft teams, depending on the availability of the interviewees. The language spoken during the interview depended on the respondent. If the respondent was non-Dutch speaking, the interviews were conducted in English. If the respondent was Dutch speaking, the interviews were conducted in Dutch.

3.3 Data collection and analysis

In order to analyse the data from the interviews, the conducted interviews were recorded after written consent from the respondents. To prepare the data for analysis, the first step then was the transcribing of the interviews. In this research, the transcribing was done in the language of the interview.
Unlike the interviews, the workshops were not recorded, as this would have created a high level of self-awareness due to the presence of the recording device, which might have caused a restraint from participants (McLellan et al., 2003). Above all, the workshops were themselves already more sensitive due to the combination of different organisations that were represented and their differing interests, and the sensitivity of the workshop subjects. This is why the researcher took notes during the workshop. A colleague and supervisor from the internship at the municipality of Amsterdam, who was one of the organizers of the workshops, presided over the workshops. Before using any data from the workshops in the research, permission was asked from the concerned participants to avoid sensitivities.

After the interviews and workshops had been conducted and transcribed and reported, the data needed to be structured and organised. By structuring and organising the data, the analysis could be processed systematically. To structure the qualitative data in this thesis, the specialised software Nvivo was used,

which allows qualitative data to be sorted and classified. An important part of the structuring of the data through Nvivo concerns coding. Coding allows the researcher to analyse data systematically and look for themes and relationships within the data. These codes are of a describing nature and divide the data to gain a clear structure. All words, sentences and paragraphs of the interviews can then be allocated to certain codes, which helps to see links and connections between different interviews or statements, which then allows the researcher to systematically analyse the data. Nvivo made coding and analysing easier, and it could obtain more professional results than manual coding (AlYahmady & Al Abri, 2013).

The analysis of the research, however, commenced with the document analysis. To analyse the documents from the document analysis, the selected documents were also coded. This was done before the interviews and workshops found place, as the document analysis served as a base for the structure of the interviews. The codes for the document analysis were however predetermined and broader than the codes used for the analysation of the interviews and workshops. The used coding scheme for the document analysis is shown in table 3.4. By using broader codes, valuable insights could emerge during the analysis, allowing a partial inductive approach.

Table 3.4 Codes document analysis

Goals and ambitions		
Socio technical constellation	Ecosystem	Public actors
		Private actors
		New actors
	Material and digital components	Digital platform
		Material elements and infrastructure
		Technical elements and infrastructure
Data	Valuation of data	Public actors
		Private actors
	Data implications	
	Privacy	
Spatial arrangements	Physical urban environment	Hubs
	Inclusivity and accessibility	
Governance	Governance models	
	Roles and responsibilities	
	Governmental instruments	
Public interests		

The chosen codes for the document analysis, the interviews and the workshops were critical for the analysis of the research and summarize required information for answering the research questions. This is why a 'coding tree' was made, which is a 'tree' consisting of multiple code branches which subdivide as the codes become more specific. At first, the code tree for the document analysis was made, based on the literature review and the research questions. For the interviews and workshops, this code tree was then complemented based on the findings of the document analysis and the interview guide. After the interviews and the workshops, more specific codes were added in new sub-categories, which allowed the data to be structured in a more detailed manner. By increasing the number of workshops and interviews, the code tree grew larger and adapted continuously until all data was structured in a manner that allowed the researcher to find certain connections, links, and effects. The code tree used for analysis in this thesis is added as appendix (see Appendix B).
By coding the documents, the interviews and the workshops, a thematic comparison was then made across all the coded elements by comparing the passages from the documents, interviews, and workshops

with similar thematic codes. In this way the codes formed the base for the analysis to find patterns and relationships that led to the answers to the sub-questions and the main question.

3.4 Research quality

3.4.1 Validity

The validity of research entails that the researcher observes, identifies, and measures what is said to be researched (Mason, 2018). Yin (2017) distinguishes multiple types of validity, being construct validity, internal validity, and external validity which this paragraph shall reflect upon.

Construct validity relates to whether a measure of a concept reflects what it is meant to reflect (Bryman, 2012). The construct validity can then be increased by using multiple evidence sources (Yin, 2017). This research complied with this as it combined the document analysis, workshops, and interviews. Another way to increase construct validity is to seek the validation of respondents by letting them criticise whether the quotes and results adequately reflect the concepts that are being studied (Noble & Smith, 2015). In this research, consent was requested for the use of quotes, and a check was conducted with certain respondents to assess whether the conclusions drawn were accurate before they were included in the findings. The internal validity refers to the establishment of causal relationships in quantitative research. This was not the aim of this qualitative research, meaning this type of validity will not be discussed further. The external validity refers to the generalisation of the findings of this research beyond the research context (Yin, 2017). The findings of this research are largely based on findings derived from a highly context-dependent case study which makes it difficult to generalise to different contexts. Some authors mention, however, that formal generalisation is overrated as the primary source of scientific progress (Flyvbjerg, 2006). This thesis did not aim to generalise its findings on a broad scale. The objective was to focus on providing detailed information without the meaning to generalise the findings. However, the findings might be of value for other municipalities, cities or countries as the results can be used to gain insight into certain barriers or problems that are experienced and into choices made and their effects on the development and implementation of MaaS in certain context-specific situations. The research findings may thus not directly apply to other cases, but they can be highly informative and offer inspiring insights and lessons learned for other places.

3.4.2 Reliability

The reliability of research refers to the consistency of the appliqued analytical procedures and whether these produce trustworthy findings (Bryman, 2012). The reliability then concerns that the operations of gathering empirical data can be repeated and create the same outcomes (Yin, 2017). Qualitative research is herein more difficult to replicate due to the relatively unstructured and personalised nature of the research process.

Several steps can be taken to increase the reliability, which were taken into consideration when conducting this research. The first way to increase the reliability concerns method triangulation (Noble & Smith, 2015). This research has applied a triangulation of mixed qualitative methods by using document analysis, stakeholder workshops and expert interviews as data resources to study the effect of MaaS on the governance of mobility systems. This also increased the confirmability and credibility of the research and results (Shenton, 2004). Another way to increase the reliability in research that uses a case study design is to provide enough background information, relevant documents, and issues about the case study at hand (Yin, 2017). This research has given background information in different sections of this thesis, like the introduction, the methods, and the results, and used multiple relevant documents. Lastly, the reliability of research can be increased by clearly describing all the steps within the research on how the data is collected, processed, and analysed (Yin, 2017). In the earlier sections of this chapter, it was described how the documents are analysed, how the workshops and interviews will be transcribed

and/or processed, and how the data was coded for the analysation. Mentioning this will not only increase reliability but will also increase the transparency of the research.

3.4.3 Ethical considerations

With the application of stakeholder workshops and interviews, it is then recommended that participants are able to speak up confidentially and know what will happen with these interviews and/or workshops (Clifford, French, & Valentine, 2010). In order to create the required level of trust, the interviewees were sent an informed consent form before the interview, which can be found in appendix D. To ensure transparency towards all participants about how the interviews and workshops have been used, a final report on the workshops, interviews and the eventual thesis was sent to the participants when desired. This way it was made apparent in what way their input has been used (Clifford et al., 2010). The reports from the stakeholder workshops can however not be included in the appendices of this thesis. The content of these reports is namely confidential and may not be shared outside the participants of the workshops. As the reports entail confidential information, specific consent will be asked whenever input is wished to be included in this research. By doing this, the participants know what will happen with specific information and when they feel the information may be too sensitive, they may decide not to have the information incorporated in the research.

4. Goals and ambitions of MaaS

This chapter will first describe why the development and implementation of MaaS is of interest to Amsterdam. Subsequently, the chapter specifically looks at what goals have been set in Amsterdam with the development of MaaS. With this, the first sub-question of this research will be answered, which is:

> *"Why is MaaS of interest to the city of Amsterdam, and what are the municipal goals for Maas in Amsterdam?"*

4.1 MaaS in the cities

Currently, various cities around the world are in the process of developing a MaaS service. The main goal of the development of MaaS for these cities is to make mobility more user-friendly (Capgemini, 2021). MaaS does this by putting the user central, instead of the transport that is currently central in mobility systems. MaaS aims to provide travellers with a flawless and efficient travel experience, and gives them more freedom of choice to organise their own journey (Capgemini, 2021). People can then determine themselves how they will get from A to B, where MaaS can offer an overview of different travel options through one personalised app (Ministerie van Infrastructuur en Waterstaat, 2020). By creating an overview with the different travel options in a transparent manner, travellers understand and appreciate the different travel options they can access. MaaS can then also contribute to the behavioural change needed to move towards the new mobility system.

MaaS is thus believed to offer a potential solution for cities in terms of mobility. Currently there are namely many cities in amongst others the Netherlands which experience mobility problems. In many developed cities, the limit of growth in infrastructure has been reached. Traffic congestions are becoming more frequent in cities, PT in cities is often overcrowded, there is an increasing pressure on physical space, and there are increasing costs and emissions that make the city unattractive for residents, entrepreneurs, and visitors (Ministerie van Infrastructuur en Waterstaat, 2019b; Ministerie van Infrastructuur en Waterstaat, 2020). The standard solutions that were previously offered such as expanding roads and railroads, allocating more financial resources for new infrastructure, and providing more subsidised funding for the PT system to manage the mobility problems, are no longer considered effective (Ministerie van Infrastructuur en Waterstaat, 2020). These solutions used to fit with the vision of governments that steered for accessibility and economic growth, and were based on the traditional approach to mobility that is reliant on ownership and usage of private cars and PT, which is also no longer deemed sufficient. This vision and approach are no longer realistic, and the quantitative increase in infrastructure and travel flows contradicts with the current policy goals that cities have regarding sustainability, liveability, accessibility, safety and inclusiveness (Ministerie van Infrastructuur en Waterstaat, 2020). Developing MaaS and using the different transport modes and infrastructure more efficiently could then result in the achievement of policy optimisation. In this way, MaaS is in different cities considered a potential solution to the currently experienced mobility problems (Ministerie van Infrastructuur en Waterstaat, 2020; Vervoerregio Amsterdam, 2021).

Furthermore, cities worldwide are convinced that with the implementation of MaaS not only mobility problems can be solved, but that MaaS can also increase the liveability and attractiveness of a city. Many cities suffer from air pollution, CO_2 emissions and congestion, and cities want to combat this with MaaS to maintain or increase the quality of life and attractiveness of the city (Ministerie van Infrastructuur en Waterstaat, 2020). According to MuConsult (2017), it is namely believed that using travel services as offered by MaaS will lead to an improvement in air quality due to the reduction of emissions, and MaaS offers the opportunity to incorporate additional sustainability incentives.

Lastly, MaaS is believed to facilitate and stimulate the transition to a healthy, clean and spatially efficient mobility system (Metropoolregio Amsterdam, 2021). Currently, cities are faced with a shortage of space for mobility and all other facilities. However, cities keep growing, which results in an ever-increasing pressure on scarce space. To achieve growth while maintaining or increasing the liveability and attractiveness of the city, the application of smart and clean mobility solutions is seen as a precondition, wherein MaaS is considered a potential solution to allow cities which are under pressure to grow in an efficient way that promotes liveability (Metropoolregio Amsterdam, 2021; Kennisinstituut voor Mobiliteitsbeleid, 2018; MuConsult, 2017). The use of MaaS' travel services is namely believed to lead to improvements in the availability of the scarce space in the urban areas, for example, by reducing the required parking areas for privately owned cars (MuConsult, 2017). And besides this, MaaS is also considered interesting because it is seen as a tool in transitioning from owning to using transport modes. With MaaS platforms, the need to own a car (or even a bicycle) decreases, as travellers always have (shared) transport modes available with MaaS (MuConsult, 2017). The shift from possession to use therefore makes the choice process in selecting a trip and transport modes more rational. With this, it is anticipated that car dependence and use will decrease, and other transport options will be chosen that take up less space (Kennisinstituut voor Mobiliteitsbeleid, 2020; Kennisinstituut voor Mobiliteitsbeleid, 2018; Vervoerregio Amsterdam, 2021). And by using vehicles instead of owning, fewer vehicles will be necessary to service the cities, which frees up scarce space. In this way, MaaS contributes to the more efficient use of scarce space in cities (Kennisinstituut voor Mobiliteitsbeleid, 2020).

4.2 MaaS goals and objectives for Amsterdam

With the development and implementation of MaaS, cities define specific goals. According to different policy documents and visions, Amsterdam has also defined several goals that MaaS is wished to achieve in the future. These goals have been drawn up by the municipality, the regional transport authority, and the metropolitan region. A number of these goals were also drawn up in consultation with, amongst others, the national ministries and private actors.

With mobility continuing to grow but reaching its limits, a new mobility system is needed. In doing so, mobility must be brought back into balance with the social and ecological reality, in which the goal is to create an integrated open 'ecosystem' of sustainable mobility. With MaaS, the aim is to create a mobility system in which sustainability, liveability, accessibility, traffic safety and more overarching policy goals can be managed. In Amsterdam, this specifically refers to achieving the fourth level of integration of MaaS, as formulated by Sochor et al. (2018), whereby integration of social value takes place by integrating MaaS into policies, visions and incentives. This requires collaboration and far-reaching transparency from all actors involved in the development of MaaS. This is also why collaborations and transparency are already being experimented with in the pilots, with the aim of learning collectively from the possibilities, opportunities and impact of data-driven mobility so that the new integrated mobility system can be optimised for policy goals, that the fourth level of integration of MaaS can be achieved and so that societal values can be protected and reinforced to the highest extent (Ministerie van Infrastructuur en Waterstaat, 2020).

According to the Kennisinstituut voor Mobiliteitsbeleid (2019), the overall goal of MaaS is to ensure a better match between mobility demand and mobility supply and to establish a more efficient mobility system. From the Vervoerregio Amsterdam (2021), it is expected that when the government adopts a regulatory role to a certain extent, MaaS can have a strong contribution to the realisation of several strategic urban challenges, namely 'from modality to mobility' and 'safe and pleasant door-to-door'. In addition, MaaS is expected to have, to a lesser extent, an effect on the challenge 'towards a CO_2 neutral

mobility system' if the mobility resources are produced and offered in a sustainable way. Besides the fact that MaaS can contribute to these strategic challenges, there are also more concrete and specific goals that apply specifically to MaaS in Amsterdam. From various policy documents, visions, agendas and studies, several goals have been formulated for the development and application of MaaS. These goals are described below;

- Reducing spatial occupancy of the mobility system. This is because MaaS aims to link supply and demand more efficiently so that ultimately fewer vehicles will be needed, with the need for ownership also decreasing (Metropoolregio Amsterdam, 2021; Kennisinstituut voor Mobiliteitsbeleid, 2019). With this, long-term parking of vehicles will also decrease, resulting in less space needed for vehicles (Gemeente Amsterdam, 2021; Gemeente Amsterdam, 2022). In addition, MaaS can also change choice processes and mobility behaviour, encouraging the use of OV and bicycles, which also contributes to reducing the spatial occupancy of the mobility system. This is reinforced when the road authority moderates these developments spatially (Vervoerregio Amsterdam, 2021; MuConsult, 2017).
- Reducing pressure on the mobility network. In the current mobility system, it is very difficult to actively prevent local congestion. Many travel planners do not consider actual congestion and offer few alternatives. As a result, travellers are unaware of the congestion, do not know of alternatives, or are not offered alternatives. In addition, there is only limited awareness of the social consequences of mobility choices. MaaS can include the social values in the algorithm with which local congestion can be countered (Vervoerregio Amsterdam, 2021). Through MaaS, it is technologically possible to spread travellers and thus reduce local congestion. This refers to the fact that MaaS will be able to divert travellers in the future and adjust planning based on real-time data to optimally inform and provide for travellers (Metropoolregio Amsterdam, 2021).
- Stimulating the transition from ownership to usage. MaaS makes finding, booking and paying for mobility easier, eliminating the need to own vehicles (Vervoerregio Amsterdam, 2021; Gemeente Amsterdam, 2021). This helps to make the city car-free. Currently, car ownership is still too attractive, largely due to former government policies that encourage car use. But with the development of MaaS in combination with adapted mobility policies, the transition to use can be accelerated (Metropoolregio Amsterdam, 2021). This transition will also contribute to reducing the pressure on the mobility network and the spatial occupancy, as fewer vehicles will be needed (Gemeente Amsterdam, 2022).
- Creating a higher-quality mobility system. MaaS makes it easier for travellers to make different (regional) trips without needing their own car, with the prerequisite that the mobility offer is of high quality. This also increases the accessibility of the mobility system (MuConsult, 2017). In doing so, with the improved digital accessibility of the mobility offerings, MaaS can also strengthen the emergence of new mobility and make the mobility system more resilient (MuConsult, 2017). This makes multimodal chain trips attractive and reduces the attractiveness that owning a private car can offer. In this way, MaaS is also according to the Kennisinstituut voor Mobiliteitsbeleid (2019), claimed to indirectly contribute to counteracting possible transport poverty and inaccessibility of the mobility system. By improving searching, booking, and paying for connecting services, the accessibility of the mobility system, and the PT system specifically, can be strengthened. This way, PT can remain the backbone of the mobility system, which is desirable given that PT runs on social services (Vervoerregio Amsterdam, 2021).
- Creating a more sustainable mobility system. MaaS enables more efficient use of mobility resources with increased occupancy rates. Namely, it can lower the threshold for the use of PT and shared mobility, and it can increase the supply of modalities. In addition, MaaS creates the

possibility of selecting trips based on emissions (Gemeente Amsterdam, 2022). A condition here is that mobility providers only use sustainable and clean means of transport. The creation of a more sustainable mobility system also supports social ambitions and initiatives toward sustainability and zero emission (Metropoolregio Amsterdam, 2021). When MaaS lowers the threshold to PT and shared mobility as part of a multimodal journey, emissions and materials used per person per kilometre also decrease (Metropoolregio Amsterdam, 2021; Gemeente Amsterdam, 2021). To encourage this use, such choices must be made attractive and self-evident (Vervoerregio Amsterdam, 2021; MuConsult, 2017).

- Creating a more inclusive mobility system. From a vision of the City of Amsterdam (2018), the goal is to make the mobility system more inclusive. Currently, the system is not (yet) as inclusive as it can be, and persons with mobility impairments cannot fully use the regular mobility system and are dependent on adapted mobility (AOV). To reduce costs and make PT more accessible, the municipality is committed to MaaS to create a more inclusive mobility system for all potential users (Gemeente Amsterdam, 2022). An inclusive MaaS system must then be set up in such a way that everyone can participate in it. Travel options for travellers in an inclusive MaaS system should not be limited in this, and everyone should have freedom of choice in selecting transportation modes or transport providers. This includes those with some form of (travel) disability (MuConsult, 2017). The goal herein is that MaaS creates a mobility system in which the financial, physical and mental accessibility of the platform, vehicles and public space is ensured. All users should have access to the essential and personalised information needed to consider travel options and make informed choices (Metropoolregio Amsterdam, 2021; Gemeente Amsterdam, 2022).
- Increasing the data position of governments. Depending on the eventual governance model of the MaaS ecosystem and the degree of cooperation with transport operators and MaaS service providers, governments can take a stronger data position. When governments have access to mobility data, the mobility system can be made smarter, more efficient, more transparent and more innovative (Metropoolregio Amsterdam, 2021). By gaining such a position, the governments can steer, monitor and optimise the mobility system on an operational, tactical and strategic level (Gemeente Amsterdam, 2022).

The goals MaaS is aimed to reach are quite numerous. MaaS is in this not a goal in itself but a means to achieve certain set goals. MaaS will not achieve all these goals independently, and other complementary services will be needed. MaaS is thus one of the different tools that can be used to try and reach these goals. MaaS does, however, have specific contributions to all mentioned goals and will therefore contribute to all the goals in its own way. But other additional actions are necessary to reach the set goals.

4.3 Sub conclusion

To conclude this chapter, it can be stated that MaaS is of interest to Amsterdam and other cities for several reasons. The main goal of MaaS is to make mobility more user-friendly by putting the users centrally and providing users with flawless travel experiences in which travellers organise their own journeys. MaaS is then believed to offer a potential solution for mobility problems that cities currently experience. Besides this, by using MaaS, cities aim to increase the liveability and attractiveness of the city, improve the public health and safety of the mobility system, and facilitate and stimulate the transition to a clean and spatially efficient mobility system. Amsterdam specifically then aims to integrate MaaS in policies to reach certain societal and public values. With this, Amsterdam has identified several goals which MaaS is aimed to contribute to. The goals for the mobility system of

Amsterdam are reducing spatial occupancy, reducing pressure on the mobility network, stimulating the transition from ownership to usage, changing choice processes and mobility behaviour, creating a higher quality mobility system, increasing accessibility and inclusivity, creating a more sustainable mobility system, and increasing the data position of governments. With these goals, Amsterdam aims to provide a better match between mobility demand and supply and establish a more efficient mobility system.

Because MaaS is still so new and innovative, and it is still unknown what the effects of MaaS will be on mobility systems and societal goals, it can be difficult to achieve the set goals. Whilst Amsterdam has stated different goals, it remains unclear what the implementation will mean in practice, and it is unsure how the transition towards this new mobility system will have to be governed. As this research aims to create more insight into this (yet unknown aspect of the development of MaaS), the upcoming chapters will look into what the transition toward MaaS might mean for the practice and mobility provision and how this new mobility system could be governed.

5. The distinctive elements of MaaS processes and the influence of mobility provision

This chapter will look at the distinctive elements of MaaS processes, being the socio-technical constellation, the data and its values, and the spatial arrangements. The chapter will do this by describing how these elements are of importance for the mobility provision and how these elements interact with the mobility system. With this, the second sub-question will be answered, which is:

"What is distinctive about MaaS processes and what do they mean for provision of mobility?"

To answer this question, this question was divided into another three sub-questions, being:

1. What is the socio-technical constellation of Amsterdam's MaaS?
2. What is the role of data in creating value for Amsterdam's MaaS?
3. How is the Amsterdam MaaS platform co-constituted with urban space?

These three questions will be answered in paragraphs 5.1, 5.2 and 5.3.

5.1 Socio-technical constellation

The design of the social-technical constellation constitutes the basis for the efficiency and development of MaaS. Here, the actors that are part of the ecosystem and the structure of the ecosystem combined with the material and technical components of MaaS form the foundation on which the development can be further elaborated. Without a stable foundation, MaaS will not reach its full potential, and set objectives will be more complicated to realise. The creation of a stable basis is therefore essential, which is why this paragraph will discuss the socio-technical constellation by clarifying how the ecosystem of actors and the digital and material components of MaaS in Amsterdam are constructed.

5.1.1 Ecosystem

The ecosystem of MaaS is a large construction, consisting of a combination of actors that already have a role in the current mobility systems and new actors that arise with the development of MaaS. The ecosystem herein also consists of a combination of both public and private actors. Table 5.1 creates an overview of the different actors present in the MaaS ecosystem of the Netherlands, displaying the combination of established and new actors, and the public and private actors.

Table 5.1: MaaS ecosystem actors and their roles in the Netherlands

Level	Stakeholder	Roles, responsibilities, and obligations
National ministries and authorities	Ministry of Infrastructure and Water management	Legislator. Responsible for transport policies and strategies. Enabler of diverse tests and pilots through legislation. Finances infrastructure investments. Owner of national transport infrastructure and responsible for the organisation and maintenance of all national roads, railways, and waterways. Responsible for the safe usage of the infrastructure.
Regional authorities	Provincial organisation	Responsible for the development of new roads, for which the province draws up plans. Responsible for the construction and maintenance of provincial roads, bicycle paths and bridges. Partly responsible for public space and its maintenance outside municipal boundaries. When there is no regional transport agency, the province serves as the commissioner of regional and local PT by issuing concessions.
	Regional transport agency	Plans, organizes, and manages PT in the region by issuing concessions and providing subsidies. Improves the operating conditions of the mobility systems and invests in infrastructure to improve accessibility and safety of the different

		modes. The regional transport agency is does not hold the position of a road manager and is therefore not responsible for public space.
Local authorities	The city and its planning department	Strategic urban and city planning. Responsible for transportation and traffic planning. Responsible for the local infrastructure and the regulation of parking facilities. Responsible for the development, management, and maintenance of local public space. Responsible for the organisation of the additional PT and the organisation of the shared mobility and cabs.
MaaS operators	MaaS company, PT operator	Combines existing transport services into one single mobile application on the principle of "one-stop-shop" and provides personalised travel plans tailored to customer's needs. Responsible for user experiences and customer service.
Transport operators	PT	Provides schedules, fares as covered by ticketing and real-time information and booking information.
	Bike sharing	Offers fares, locations (bikes, docking stations and hubs) and availability.
	Car sharing	Provides fares, vehicle information, booking information, availability, and locations.
	Taxi	Provides fares, vehicle information and booking information.
Mobile service operator	Third party technology, ICT, and service providers	Provides the key enabling technologies and services (such as payment and mobile ticketing) to MaaS operators and transport service providers. Can bundle its supply in comprehensive mobility service packages to best serve the end user, by satisfying an integral need for mobility.

Source: author

In the table shown above, it can be seen that various governmental levels are involved in the MaaS ecosystem. For the four governmental levels with tasks, roles, and responsibilities for the provision of mobility, the responsibilities of the governmental parties can be specified for several modalities. Table 5.2 describes the tasks, roles, and responsibilities of the governmental actors for the modalities that are under the control of the governments. Private modes of transport are not included as the government has no direct control or responsibility over them.

Table 5.2 Responsibilities governmental actors per modality

	PT	**Additional PT**	**Shared mobility**	**Taxi**
State: Ministry of Infrastructure and Water management	Organizes national legislation through the WP2000 (passenger transport law). And organizes national concessions for PT by train	Organizes the WMO (social support law) and provides municipalities with municipal funds to provide the needed additional PT amongst others.	No role/task. Legal adjustment is desirable though, as is a role in the inspection of vehicles. The state needs to create the base to operate properly as road authorities.	Organizes the legislation on taxis in the WP2000
Province: Noord-Holland	Regional road manager and regional public space manager. And organizes the PT concessions, unless there is a regional transport agency operating.	No role, unless there is a central coordination, which is a supra-municipal cooperation, which sometimes is mandated.	No role. Can however issue non-exclusive contracts in which competition may not be eliminated in the process. Mandating can be done if the municipalities themselves do not want to organize the permit	
Regional transport agency: VRA	Organizes concessions for PT and is responsible for tram stops. They do not fulfil the role of road authorities (opposing the province)	No role. Chances seen to integrate the additional PT with the regular PT.	No role. Can however issue non-exclusive contracts in which competition may not be eliminated in the process. Mandating can be done if the municipalities themselves do not want to organize the permit	

Municipality: Amsterdam	Local road manager, permits access to PT, can open up/shut down areas for transportation. Responsible for the design of public space, the construction and maintenance of PT stops and parking facilities.	Commissioner, in which Amsterdam organised the additional PT in a concession form. Ambition is to integrate additional PT with regular OV.	Prohibits, licenses, or grants concessions for shared mobility, including service areas and asset quantities.	Prohibits, licenses or grants concessions for taxis.

Source: author

In addition to these public parties, there are also several private actors that play a role in the current and future mobility provision in Amsterdam and are therefore part of the MaaS ecosystem (TNO, 2020). A basic description of the private actors and their roles was already given in table 5.1, but the private actors are not yet incorporated into table 5.2, since it is not yet certain which tasks, roles and responsibilities will be assigned to which actors. The tasks, roles, and responsibilities of the private actors of the ecosystem of the mobility system of Amsterdam are explained below as far as possible.

First of all, the MaaS operators are part of the MaaS ecosystem. Amaze is an active MaaS platform in Amsterdam to which all forms of mobility are connected and which can be used to plan, book, pay and travel (Contract manager MaaS Amsterdam, 2022). Amaze is however still in development. The Rivier platform is also part of the Amsterdam MaaS ecosystem as a MaaS operator. Rivier is a joint venture of three PT operators (HTM, RET, NS) which aims to build a platform in which it can offer its own MaaS services which other transport operators can then connect to (Workshop 2, 2022). Rivier is still in the process of developing its service and is thus not operable yet. In addition, 9292 and Google are involved in the MaaS ecosystem as travel planners.

Other private actors that play an essential role in the mobility system are the transport operators. Here, the largest actors are the PT operators. In Amsterdam, the parties responsible for the organisation of PT are NS (national railway), GVB, Connexxion and R-net (local operators). The shared mobility can be divided into several categories. The car-sharing operators in Amsterdam are MyWheels, GreenWheels, Fetch, Sharenow, Sixt, Amber and Snapcar. The shared bicycle operators are Cargoroo, OV fiets (NS), GoAbout and Donkey republic. And the shared scooter operators are Felyx and Check. Uber is also operational in Amsterdam as a ride-hailing service, and there are various taxi services available.

In addition, there are also parties responsible for the collection, organisation, processing, and distribution of mobility data. These include the NWD, DOVA and Translink. There are also several research parties active in the MaaS ecosystem, such as TNO, ACM and various universities and educational parties (Workshop 1, 2022; Workshop 2, 2022). In addition, several mobility interest groups are part of the MaaS ecosystem in Amsterdam, such as the ANWB and the Mobility Alliance. Lastly, various ICT operators, media, marketing, advertising, and insurance companies are also involved in MaaS.

New roles and actors

With the introduction of the new roles and actors created by MaaS, the mobility provision changes enormously (Independent MaaS consultant, 2022). The new roles and actors create a growing complexity of the ecosystem and changing dynamics (Project manager innovation office Amsterdam, 2022). With the emergence of more actors, both the ecosystem and the business models of actors will become more blurred and interactive. It is herein possible that one actor takes on several roles, or one role can be taken on by multiple actors. This makes the ecosystem blurred. It is not yet known how the ecosystem will change and how this should be organised (Consultant urban systems, 2022).

Many roles that are part of the new ecosystem already exist in the current ecosystem. With MaaS, the interpretation of these roles may change. However, the role of the MaaS operator is completely new, with platforms acting as digital mediators between the transport operators and the users (Vervoerregio Amsterdam, 2021). With these changing dynamics, there will be multiple new actors in the ecosystem, and existing parties may take on different/new roles (Consultant urban systems, 2022). It is therefore important for the success of MaaS that all actors can connect in the ecosystem and that the roles of different actors are clearly divided (Contract manager MaaS Amsterdam, 2022; Ministerie van Infrastructuur en Waterstaat, 2020; MaaS Alliance, 2021; TNO, 2020):

> *"It is chaos in the ecosystem, it is not clear what roles actors have and how the ecosystem is structured. The roles and responsibilities are not (yet) clearly allocated to the actors, and everyone is searching for clarity. How the various actors, both public and private, will assume their roles is crucial to the development of MaaS."*
>
> Personal communication, Contract manager MaaS Amsterdam (2022)

Besides this, the success of MaaS, and specifically MaaS operators, depends on the relationships with customers (Project manager Smart and shared mobility and MaaS, 2022; Workshop 1, 2022). A connection with the customer is a requirement for the development of a business model:

> *"Without customers, you have nothing. The actor who can reach customers the fastest is more likely to survive, be successful and decide the game."*
>
> Personal communication, Consultant Smart mobility platform MRA (2022)

Existing transport operators often already have a relationship with the customer. For new transport operators and MaaS operators, it is difficult to enter the mobility system without depending on the established actors, as the new actors do not yet have this customer connection and experience. In this way, the current monopolies hinder the development of new actors. However, the development of MaaS attracts not only new but also existing actors (Program manager hubs and smart mobility Amsterdam, 2022). The existing actors want to be involved in the development of MaaS and secure their core business. In doing so, the PT operators want to gain advantages without compromising their customer relationships. However, this is at odds with the open ecosystem in which all actors must be equal. By working together and joining forces, a more attractive alternative for travellers could be created, which could result in an increase in people using MaaS. This way, the platforms and the transport operators will all collectively get more customers, and everyone will benefit from the development of MaaS (Project manager Smart and shared mobility and MaaS, 2022).

Collaboration

From several interviews, it becomes apparent that collaboration is seen as the most important aspect in the development of MaaS (Policy advisor innovative mobility VRA, 2022; Project manager innovation office Amsterdam, 2022). It is mentioned that the development of MaaS starts with collaboration, trust and making agreements (Contract manager MaaS Amsterdam, 2022; Project manager Smart and shared mobility and MaaS, 2022; MaaS Alliance, 2021). If there is no trust and transparency between the actors, no collaboration can occur, which means that no good integrated app can emerge that can serve the user with sufficient options (Ministerie van Infrastructuur en Waterstaat 2020; Transport researcher, 2022). The arrival of the new roles and actors thereby affects the collaboration between actors that are part of the ecosystem (Independent MaaS consultant, 2022). In the new and complex ecosystem, a new form of collaboration will have to be found, but it is still unclear what that should look like. It is believed to be important that the actors trust each other, make joint agreements, and create a shared vision that everyone

supports (Consultant urban systems, 2022; Transport researcher, 2022). The collaboration and transparency between governments, transport companies and MaaS operators are thus essential for the success of MaaS (Ministerie van Infrastructuur en Waterstaat 2020), which is confirmed in an interview:

> *"As long as there is no collaboration between the government and private actors, and between the public and private actors themselves, and there is no organisation of preconditions, MaaS will be just a technical tool and cannot be used to optimise the mobility system with a shift in efficiency. MaaS will then remain just technology."*
>
> Personal communication, Project manager Smart and shared mobility and MaaS (2022)

The Netherlands, unlike other countries, applies a public-private approach, in which the government works with transport operators, app developers, data suppliers, platform services and research institutions (Ministerie van Infrastructuur en Waterstaat 2020). From the public-private partnership, several national pilots are being worked on, which are a learning school for the development of MaaS in the Netherlands (Capgemini, 2021). Herein, the private actors take the initiative to develop MaaS services whereby they can receive start-up subsidies from the governments, provided that they comply with conditions drawn up by the governments. With these conditions, the governments aim for a level playing field in which all actors can connect and compete without creating a monopoly, stimulating the creation of MaaS and mobility innovation (Capgemini, 2021). The governments themselves do not offer any services in this respect but facilitate the collaboration (TNO, 2020). By working together, the aim is then to find a balance between the economic, ecological, and public interests of MaaS (Ministerie van Infrastructuur en Waterstaat 2020).

5.1.2 The digital and material components

Digitalisation and platformisation as global societal trends have been the cause of the development of MaaS (Ministerie van Infrastructuur en Waterstaat, 2020; MuConsult, 2017). The mobility transition brought about by MaaS is primarily focused on the change from physical to digital (Workshop 1, 2022). The digital and technical components that form the basis of the MaaS platforms appear in the form of an application that functions as a digital interface between operators and travellers (MuConsult, 2017; Consultant Smart mobility platform MRA, 2022). But behind this is a whole technical and digital world that requires digital integration (MaaS strategist Amsterdam, 2022). The digital and technical basis is developed by the private actors in the ecosystem and made available to users. The public actors do not develop the apps themselves. The private actors are expected to be better able to do this because of the knowledge and expertise that private actors have and that public actors lack (Policy advisor innovative mobility VRA, 2022). The government does set frameworks and requirements for certain aspects of technical developments, such as certain standards for data sharing and interoperability. With this, the government creates the minimum conditions that private actors are required to comply with. The government can enforce this through the public-private collaboration. The objective of the governments is then to facilitate the creation of an open ecosystem and a fair level playing field. In this way, the government protects a healthy ecosystem, which ultimately benefits the users (Project manager innovation office Amsterdam, 2022; Workshop 2, 2022).

With the creation of the platform as a digital layer, MaaS operators can share information about travel needs with transport operators so that the needs and wishes of travellers can be better met, and mobility demand and supply can be better matched (MuConsult, 2017). The platform thus provides travellers with more insight and convenience. By integrating mobility, multimodal travel becomes more transparent and easier, which makes alternative travel more attractive to users (Consultant Smart mobility platform MRA, 2022, Transport researcher, 2022).

The technical development is thus extremely important for the effectiveness of MaaS, and herein is the interoperability the most important technical task of MaaS. This means that the apps and operators can communicate with each other automatically. This then requires a technical deep integration. With this, there is considerable work still to be done in the area of the technology behind MaaS. The technology is not yet ready for the full effectiveness and implementation of MaaS and must be developed further (MaaS strategist Amsterdam, 2022). But although MaaS is seen as a digitalisation layer of mobility through technical developments, MaaS also has a material aspect. MaaS as a platform is highly material because the activities that MaaS makes possible are rooted in materiality. MaaS does not have a spatial appearance per se, but MaaS is inextricably linked to and dependent on vehicles, the physical infrastructure and the spatial and material facilities. MaaS cannot exist without physical elements and the physical infrastructure, so even though MaaS is essentially a digital service layer, it is linked to the spatial and material aspects (Contract manager MaaS Amsterdam, 2022). For MaaS to work, it is therefore also necessary that there is a sufficient supply of vehicles and transport operators (MuConsult, 2017). After all, MaaS does not create new mobility; it merely changes how mobility is used (Transport researcher, 2022; Consultant urban systems, 2022). Amsterdam herein aims to cause a behavioural change and stimulate the transition from vehicle ownership to usage (Project manager innovation office Amsterdam, 2022; MaaS strategist Amsterdam, 2022), as also mentioned in §4.2. With MaaS, travelling by non-owned vehicles becomes easier and more self-evident, thus contributing to the objectives of 'reducing spatial occupancy of the mobility system', 'reducing pressure on the mobility network' and 'creating a higher-quality mobility system' (Consultant Smart mobility platform MRA, 2022). A policy advisor on innovative mobility from the regional transport agency explains:

> *"With a good MaaS system, the need and temptation to own or buy a private car is reduced, thus changing people's behaviour. In addition, owning private vehicles is a barrier to using non-owned vehicles, as it is not financially attractive and privately owned transport offers great convenience and comfort."*
>
> Personal communication, Policy advisor innovative mobility VRA (2022)

All vehicles make use of the physical infrastructure, but in the new mobility system with MaaS, the digital infrastructure is also important, as it can facilitate data organisation and digital communication between different actors. In addition, the digital infrastructure can help to organise and manage the mobility system, to harmonise supply and demand, and to serve the traveller. This will enable the mobility system to be organised more efficiently, which is necessary given that the limits of physical mobility growth have been reached (Workshop 2, 2022). Therefore, the government will have to invest in a data infrastructure (Project manager innovation office Amsterdam, 2022). Just as agreements have now been made about the physical infrastructure to keep the mobility system safe and efficient, agreements will also have to be made about the use, maintenance, and security of the digital infrastructure. But the ownership, maintenance and responsibility for this digital infrastructure have not yet been arranged (Workshop 2, 2022).

The socio-technical constellation focuses on the social and technical parts of a system, and the materialities and the environment the system exists in and makes use of. The social element refers to the ecosystem of MaaS and its structure, specifically relating to existing and new actors and their tasks, roles, and responsibilities. The technical part refers to the digital integration and technologies MaaS relies on, in which the technical components that form the basis appear in the form of an application that functions as a digital interface. This also includes the digital infrastructure that facilitates the technical

organisation. These technical foundations are then created by the actors from the ecosystem, which function as digital mediators in MaaS' ecosystem. The technical development is the foundation of MaaS, but the social development is also fundamental for MaaS' development. Besides the social and technical aspect, MaaS its activities are rooted in materiality since it is dependent on vehicles and exists and relies on the use of physical infrastructures and spatial facilities. MaaS cannot develop or even exist without these elements. And to accomplish the set objectives Amsterdam drafted, all these elements should be integrated and collaborate.

5.2 Data

The role of data in the mobility system relates to how data can be used to organise the mobility provision, and to make the mobility system more efficient (Vervoerregio Amsterdam, 2021). Data is the enabler of MaaS, with the digitisation behind it creating the service layer that needs to be fed by the data. Data forms the basis for MaaS to be able to meet the traveller's mobility needs at the micro level and to measure and influence the impact on the mobility system and society at macro level (Independent MaaS consultant, 2022; Workshop 2, 2022). In this way, data can provide a grip on the mobility needs and their consequences for the mobility system (Metropoolregio Amsterdam, 2021). Data is thus valuable for all actors in the ecosystem. Without data, the provision of information to travellers concerning personalised travel advice and available vehicles cannot be optimised, while that is precisely what MaaS relies on (Independent MaaS consultant, 2022). This section will therefore take a closer look at the relationship between MaaS and data and its value.

5.2.1 Value of data

The data on travel, behaviour, choices and wishes of travellers and the large transport flows in areas are of great value for transport operators, MaaS operators and for governments and the development of public policy (Ministerie van Infrastructuur en Waterstaat, 2020). Data is therefore an asset of great value to both public and private actors (Transport researcher, 2022; MaaS strategist Amsterdam, 2022). For the different types of actors, the value creation of the data can be found in different aspects.

Private actors

The various private actors in the MaaS ecosystem all have their own differing interests that they pursue. They focus on certain general objectives, such as offering smart and sustainable mobility, but they are mainly focused on their own growth opportunities. They do this mainly by applying data. The mobility data is crucial for the development of effective and profitable mobility services and/or MaaS apps, and for the creation of a profitable business case (Ministerie van Infrastructuur en Waterstaat 2020, Vervoerregio Amsterdam, 2021). Therefore, mobility data is one of the most important assets for the successful development of many private actors. And many private actors collect mobility data directly because travellers use their services, and thus travel information flows into the hands of transport operators and MaaS operators (Workshop 2, 2022).

Because the mobility data is so important for the creation of the business case and the development, most private actors want to retain their data as a means of generating capital. Their access to data can be seen as a comparative advantage compared to other actors who do not have direct access to the data (Ministerie van Infrastructuur en Waterstaat 2020; Consultant urban systems, 2022).

Public actors

Public actors also attach great value to mobility data. For governments, data is mainly a resource to gain insights into the mobility system, and the data creates the possibility for governments to steer and optimise the mobility system and mobility behaviour (MaaS strategist Amsterdam, 2022; Project

manager Smart and shared mobility and MaaS, 2022). This makes the data mainly a source of knowledge for governments.
The municipality wants to have as much insight as possible into the mobility system because they have a duty to keep the municipality as liveable as possible. The data helps the municipality to see what is happening in the city. With more data, there is also more knowledge and insight that can help the municipality organise mobility more efficiently (Policy advisor innovative mobility VRA, 2022). Governments also state that they want to operate in a data-driven way and construct policy and policy choices based on mobility data (MaaS strategist Amsterdam, 2022). Currently, policy choices are not based on data. Data can then provide a burden of evidence as to whether the right choices are being made based on policy. In this way, data can help to substantiate policy- and project-related choices (Policy advisor innovative mobility VRA, 2022). But with real-time data, governments can also manage the mobility system more intelligently (Metropoolregio Amsterdam, 2021). The insight into mobility behaviour can then be used as input to steer mobility, change the mobility provision or optimise the mobility system. The more data that is available, the smarter choices can then be made (Program manager hubs and smart mobility Amsterdam, 2022). And based on real-time data, the municipality wants to use nudges to tempt people to adjust their mobility behaviour and improve the public space:

> "*We learn about mobility behaviour in certain places and at certain moments, which allows us to determine how best to respond to it. Data then ultimately helps to better regulate and organise the mobility supply, which may cause people to change their mobility behaviour*."
> Personal communication, Program manager hubs and smart mobility Amsterdam (2022)

To manage mobility and optimise the mobility system, the right data must be collected. It must be clear what the municipality aims to achieve and what data is needed to do so (MuConsult, 2017; Workshop 2, 2022). Currently, it often remains unclear to local authorities what data is needed to achieve their goals. Municipalities often do not know how to handle data because there is very limited knowledge about the processing and application of data. There is still a large knowledge and expertise gap among the governments about what can be done with the data and how this leads to insights (Consultant Smart mobility platform MRA, 2022). That is why people who work with data and policy need to integrate, so that the right insights emerge and policy can be communicated digitally (MaaS strategist Amsterdam, 2022). If the municipality does not know how to use the data, there will be no efficiency and optimisation.

5.2.2 Data sharing

The government would like to receive data to gain insights into the mobility system and to be able to manage and optimise the mobility system. But the government itself does not receive data directly. The majority of the data is, as previously mentioned, directly collected by the transport operators and MaaS operators. The governments would like a position in the data infrastructure, but this is not always easy, as private companies do not like to distribute their data (Transport researcher, 2022). The sharing of data is therefore an essential condition for the development of MaaS. Without data, the development and optimisation of the mobility system is impossible (Ministerie van Infrastructuur en Waterstaat 2020). Governments need the data for insights and for managing the mobility systems (MaaS strategist Amsterdam, 2022; Project manager Smart and shared mobility and MaaS, 2022), and transport operators and platforms need data to provide travellers with up-to-date, real-time data on personalised travel advice and the quality aspects of the connected modalities (MuConsult, 2017). MaaS thus needs to be fed with data so that it can work optimally. Without data sharing, MaaS will not be able to develop further and reach its potential (Workshop 2, 2022).

5.3 Spatial arrangements

As mentioned earlier, MaaS as a digital service layer is purely technical and has in its appearance no spatial aspects. MaaS is, however, dependent on and inextricably connected to physical space through the vehicles, infrastructure and spatial facilities that are part of the mobility system. The co-constitution with urban space therefore concerns the relationship between MaaS and the physical environment in which MaaS operates. The appropriate coordination between the technical and physical elements of the mobility system is important for creating a high-quality mobility system. This section will elaborate on the alignment of these elements to clarify the co-consistency of MaaS and urban space.

5.3.1 Relation MaaS and physical space

The increasing pressure on public space requires space-efficient solutions. MaaS offers opportunities to make better use of scarce space (MuConsult, 2017), and offers an answer to the social challenges of mobility poverty, lack of accessibility and pressure on the mobility system (Kennisinstituut voor Mobiliteitsbeleid, 2020). MaaS redefines the way mobility is offered and consumed (MaaS Alliance, 2021), by offering cleaner and smarter alternatives to the mobility system (MuConsult, 2017). But this requires a different spatial layout and new ideas for developing areas (Metropoolregio Amsterdam, 2021). The mobility system is currently primarily designed for car use, which promotes car use. But car use takes up a lot of valuable space, relatively speaking, compared to other means of transport such as PT and active transport (Kennisinstituut voor Mobiliteitsbeleid, 2019). In addition, shared mobility is not yet facilitated in the mobility system. The orientation towards privately owned vehicles and the lack of organisation for shared mobility form a barrier to the development of MaaS (Project manager Smart and shared mobility and MaaS, 2022), and make the mobility system chaotic for the user:

> *"The organisation of shared mobility is dramatic for (potential) users. It is not clear where you can or cannot drive, or where you can or cannot park shared vehicles, which makes it very unattractive."*
>
> Personal communication, Independent MaaS consultant (2022)

Public space can be enabling for MaaS if the space is designed accordingly. But as long as the space does not reflect what the municipality wants to achieve with its mobility system, the system will not develop optimally, and MaaS will not be able to reach its full potential (Independent MaaS consultant, 2022). The municipality is the manager of the space and thus has a decisive role in the success of MaaS, as they are responsible for the development of the space (Policy advisor innovative mobility VRA, 2022).

MaaS itself does not develop public space, but it does benefit from the physical changes that facilitate multimodal travel and change mobility behaviour (Contract manager MaaS Amsterdam, 2022). MaaS influences the mobility behaviour and mobility choices that people make and will possibly change these, which in turn will influence the development of public space in indirect ways (Project manager Smart and shared mobility and MaaS, 2022; Consultant urban systems, 2022). For example, MaaS contributes to the transition from ownership to use, which means that cars will take up less space on the street, which then contributes to more efficient use of space and less pressure on the mobility system (Kennisinstituut voor Mobiliteitsbeleid, 2019; MaaS strategist Amsterdam, 2022). The freed-up space can then also be organised in other ways that can increase the liveability of the city (Project manager innovation office Amsterdam, 2022; Consultant Smart mobility platform MRA, 2022).

But the design of physical space can also influence the development of MaaS. By adapting or rearranging the space, certain mobility behaviour can be stimulated, and people can make other mobility

choices. In this way, MaaS can be facilitated and stimulated (Policy advisor innovative mobility VRA, 2022):

> *"If people cannot park a car in front of their house because there is no space or the parking norm is low, people are more likely to use other transport, which stimulates the use of alternatives instead of the privately owned car"*
>
> Personal communication, Project manager innovation office Amsterdam (2022)

The relationship between public space and MaaS then also relies on data. This is because data enables governments to direct and control public space. The municipality wants to receive data from the MaaS operators so that they can gain insights into mobility behaviour, so they can then direct the transport operators by communicating their policy digitally (Program manager hubs and smart mobility Amsterdam, 2022). Data then teaches the municipality where there is a need for certain designs, such as where to place shared mobility and how to best organise the transfer locations between different modalities (MaaS strategist Amsterdam, 2022). The municipality can then instruct the transport operators on how to do this so that mobility is made more accessible to users. This way, data can help regulate and organise mobility, and public space can be better controlled or adapted (Gemeente Amsterdam, 2021).

Spatial design of hubs

As mentioned, the public space and mobility system are currently mainly designed to facilitate privately owned transport, and shared mobility is not yet facilitated in the public space. One way to offer shared mobility is through the principle of hubs. Hubs are nodes in a multimodal mobility network where different forms of mobility and infrastructure come together (Gemeente Amsterdam, 2021; Policy advisor innovative mobility VRA, 2022). The hubs are interconnected and interchangeable. (Gemeente Amsterdam, 2021). By placing hubs, multimodal travel is made easier and is being promoted, because the traveller can change forms of mobility in one place that efficiently organises the mobility space as an exchange point. Hubs thus make the use of transport other than the privately owned car easier (Independent MaaS consultant, 2022; MaaS strategist Amsterdam, 2022). In addition, hubs offer security and visibility for its users, because in the hubs there are (almost) always different and sufficient means of transport available (Project manager innovation office Amsterdam, 2022) Logically, it is a requirement that the hubs always have sufficient supply (MaaS strategist Amsterdam, 2022). For the use of the hubs, the recognisability and visibility are of great importance (Contract manager MaaS Amsterdam, 2022; Consultant urban systems, 2022). For this, an unambiguous spatial design is desirable (Gemeente Amsterdam, 2021; Independent MaaS consultant, 2022).

The placement of the hubs is also essential for the attractiveness of the hubs as a travel alternative. If the hubs are too far or require a lot of effort to reach, it is deemed unattractive which will result in low adoption rates (Consultant Smart mobility platform MRA, 2022).

Hubs are also an instrument for the municipality to manage public space. The municipality is namely responsible for facilitating the hubs, which must be recognisable and attractive, and may not cause any spatial disturbance (Independent MaaS consultant, 2022; Metropoolregio Amsterdam, 2021). By facilitating the hubs, the municipality can exert more control over the urban space and mobility, with which the municipality aims to make the city more liveable and accessible. The hubs then contribute to the creation of a car-free, liveable, sustainable, and accessible city with a more space-efficient mobility system. Additionally, the hubs thus seem to have an effect on the success rate of MaaS, because the assured availability of alternative travel modes and the spatial context facilitated by the hubs promote multimodal travel and the use of MaaS (Project manager Smart and shared mobility and MaaS, 2022).

5.3.2 Inclusivity and accessibility

With the application of MaaS, Amsterdam identifies many opportunities to contribute to the accessibility and inclusiveness of the mobility system (MaaS Alliance, 2021; Program manager hubs and smart mobility Amsterdam, 2022). As already shown in §4.2, MaaS aims to create a mobility system that is more inclusive and accessible.

With MaaS, travellers are provided with integral information. Travellers see which options are available and receive personalised travel advice, enabling them to make a well-considered choice about their journey. Facilities (and information about the facilities) for people with a (mobility) impairment can also be integrated and offered more easily. By integrating the information and possible facilities, travelling for mobility-impaired people becomes easier and more accessible (Project manager innovation office Amsterdam, 2022; Gemeente Amsterdam, 2018). Also, the MaaS app can apply specific arrangements, such as discounts, or assistance (Program manager hubs and smart mobility Amsterdam, 2022).
In addition, the integration achieved by MaaS allows operators and the municipality to see all mobility options in a single image, allowing them to see where the supply is and is not present and where it should be better facilitated (Transport researcher, 2022). In this way, operators and the municipality can see what wishes travellers have, which enables them to offer mobility more effectively, especially for those who need adjusted travel facilities (Policy advisor innovative mobility VRA, 2022).

The municipality is responsible for providing an inclusive mobility system, and for providing access to transport for certain target groups. Private actors often do not do this on their own, because of the business case, seen the provision of the inclusive aspect is not considered profitable (Workshop 2, 2022). Governments must then commit to create an inclusive and accessible mobility system (Gemeente Amsterdam, 2018; Gemeente Amsterdam, 2020). This is why the municipality finances the additional PT. And for the PT, governments subsidise the routes that are not profitable, but there is a reluctance to also subsidize shared mobility. To create a more inclusive mobility system, governments should look at the system integrally. They should then set goals and facilitate what is needed to achieve them (Consultant Smart mobility platform MRA, 2022: Transport researcher, 2022).

Currently, ‘normal’ PT and additional PT still operate separately. The various forms of mobility are organised separately from each other. By integrating the systems, the inclusiveness of the mobility system can be increased (Project manager innovation office Amsterdam, 2022). By integrating the different modalities and by providing sufficient information about travelling, but also about the vehicles and other facilities, the barrier for persons with a certain (mobility) impairment can be reduced (Policy advisor innovative mobility VRA, 2022). Amsterdam is trying to remove the barriers towards an inclusive mobility system (Workshop 1, 2022; Gemeente Amsterdam, 2020).

Geographical comprehensiveness

An accessible mobility system also aims to cover the entire area it serves. Many mobility services provided by private actors operate mainly in the city centre, because this area is highly profitable. In the less popular locations, transport is less present, because it is less profitable. PT operates both in the city centre and outside it. This is mainly because the unprofitable routes are subsidised by the authorities (Workshop 1, 2022; Project manager innovation office Amsterdam, 2022). The areas that are interesting for transport operators, however, have the least societal value as these areas are already served by existing connections. The areas that are currently less well connected are an enrichment from the societal value perspective. But these areas are not commercially attractive (Workshop 1, 2022). It would be interesting to explore whether the PT status can also be arranged for other services so that they are also

present in the 'weaker transport areas'. This would also allow mobility to be demand-driven, which is more efficient and offers perspective when PT has to be cut back (Project manager innovation office Amsterdam, 2022; Workshop 1, 2022).

In order to create a geographically comprehensive system that does not only serve the commercially attractive areas, local agreements must be made between the municipality and the transport operators. The direct role of MaaS in creating a geographically covering system is very limited (Consultant Smart mobility platform MRA, 2022). MaaS can be deployed by connecting all modalities and providing insight into where mobility is located, and by making this more accessible to users. But MaaS itself does not provide the vehicles and cannot ensure that mobility is offered at certain locations (MaaS strategist Amsterdam, 2022; Program manager hubs and smart mobility Amsterdam, 2022). With its insight, MaaS can make it clear where the mobility is and where it is not, and thus find out which places need to be facilitated better (Transport researcher, 2022). The creation of a geographically comprehensive system must therefore mainly come from other developments and policies, such as the agreements in concessions, permits and exemptions (Program manager hubs and smart mobility Amsterdam, 2022). To create a geographically comprehensive system and to achieve societal added value, the different transport operators should collaborate and make arrangements with each other, the MaaS operators and the municipality (Project manager Smart and shared mobility and MaaS, 2022).

5.4 Sub conclusion

In this chapter, an answer was given to the question:

"What is distinctive about MaaS processes and what they mean for provision of mobility?"

This was done by discussing the socio-technical constellation, the value of data and the spatial arrangements of MaaS in Amsterdam. Concerning the socio-technical constellation, the new ecosystem brings a growing complexity due to the introduction of new actors and roles, the required new organisation of the existing actors and roles, the changing relationships between actors, and the coherence of the existing and new elements. This causes the ecosystem and the business models of actors to become more blurred and interactive, which adds to the findings of Van den Hurk et al. (2021), Fenton et al. (2020) and Repette et al. (2021). But with the reshaping of the mobility systems and the arrival of new actors, it remains unclear how the ecosystem will change. In this, there is a need for a clear structure and division of roles in the ecosystem. This corresponds to van der Graaf and Ballon (2019) and Barns (2019). The collaboration is essential in this regard as the public and private actors need each other to realise MaaS platforms in society, as also shown by Lee et al. (2020). The creation of trust and transparency is the basis for the collaboration between the various actors in the ecosystem and thus also the basis for creating an open, fair, healthy ecosystem and a level playing field, which is necessary for MaaS to develop and innovate. That is why in the Netherlands, a public-private approach is applied, with the aim to create a balanced organisation from which all actors can benefit. This network where both public and private actors are present is characteristic of PU, as the ecosystem is severely dynamic and complex (Caprotti et al., 2022). MaaS is herein the digital service layer which integrates everything. The digital infrastructure, technical development and technical interoperability between actors are then crucial for the operation of MaaS, as the technical tools enable collaboration in the ecosystems (Repette et al., 2021). MaaS as the digital layer then makes the supply and use of mobility more transparent. And the digital infrastructure can help to organise the mobility system and serve the user. However, MaaS is as a digital platform not merely technical since it is embedded in materiality due to its inextricably link to vehicles and the physical infrastructure, corresponding to Caprotti et al.'s (2022) findings.

The collaboration between actors is also essential for data sharing. Mobility platforms like MaaS depend on data and cannot develop without mobility data, which also became apparent by Caprotti et al. (2022). Docherty et al. (2018) add to this by mentioning that data as a new concept within MaaS platforms is a new element of governance of mobility systems and is the most valuable commodity. This research adds to this by stating that the data is an asset of great value to both the private and the public actors in the ecosystem. For private actors, data is a way of capital generation which is deemed essential for creating a profitable business case. For public actors, however, data is a means of knowledge creation which creates insight into the mobility system, from which mobility can be organised, controlled, and steered, which may lead to optimisation of the mobility system and mobility behaviour. Besides, the governments also want to operate in a data-driven way and construct policies based on mobility data. Herein is the capture, integration and sharing of data essential for the optimal operation and service provision of MaaS. With this, the data occupies a central role in the functioning of platforms and is crucial for the functioning of platforms in the theory of platform capitalism and for the efficiency of the mobility system (Caprotti et al., 2022). In this way, the technological capital of data becomes more deeply entrenched in the UPE of cities. PU and MaaS then aim to use the technical tools and collaboration to solve experienced challenges like data sharing (Bauriedl & Strüver, 2020; Sadowski, 2020), which the next chapter will elaborate upon.

For a successful implementation, MaaS also depends on a good integration with public space. In the concept of PU, it became apparent that the platforms are flexible arrangements which are not bound to specific territories, but which do rely on territorialised networks and existing infrastructure (Srnicek, 2016). This also applies to MaaS, since MaaS is inextricably connected to the physical space and offers opportunities to make better use of scarce space. So although MaaS does not have a spatial appearance, it does intervene in space by using it. This is also confirmed by van den Hurk et al. (2021). PU and MaaS thus have a strong spatial and material component. The data and technology enable the platforms to abstract from space and are crucial to the operation and functioning of the platform, but the physical elements like the infrastructural networks and physical goods make the platforms bound to locations and dependent on materials, as has also been made clear by Caprotti et al. (2022).
But currently, the physical space is not yet designed for shared mobility and MaaS, as it is aimed at facilitating the privately owned car. For MaaS to develop optimally, the space then should reflect what the municipality wants to achieve with its mobility system. And mobility can for example be offered in public space trough the concept of hubs. To change space and reflect the objectives of the mobility system, the space and also policies will then have to be adjusted, which can be done based on the insights that are gained through data. The physical public space and MaaS have herein a mutual influence on each other and can reinforce each other by influencing and stimulating certain mobility behaviour. In doing so, MaaS will also try to make the mobility system more inclusive and accessible. This is mainly a challenge in the less popular locations, as transport is less present here due to its lack of profitability.

In this chapter the distinctive elements of MaaS were thus discussed, structured around the categories of the socio-technical constellation, the data and its value, and the spatial arrangements. The findings from this chapter largely coincide with and are complementary to the conceptualisation of PU and the theoretical concept of UPE. But this chapter has not yet looked at the effect of these elements on the governance of mobility systems. These elements introduce new dimensions into the conventional planning practices, and they implicate certain questions for the governance of mobility systems and mobility platforms such as MaaS, which will be discussed in more detail in the following results chapter.

6. Governance of MaaS

This last results chapter will take a closer look at the governance of MaaS by looking at how MaaS can be governed to ensure public value and societal goals. With this, the last sub-question of this research will be answered:

> *"Given these characteristics, how could municipalities govern MaaS to ensure public value & equitable access to mobility and achieve municipal goals?"*

The characteristics have been described in the previous results chapter and will be further built on in this chapter, as this chapter commences with treating the governance implications of the characteristics of the socio-technical constellation, the data and its value, the spatial arrangements, and besides this also the implications regarding legislation and regulation. After this, the possible governance models, the public interests, and several recommendations regarding the governance of MaaS will be discussed accordingly.

6.1 Governance implications

6.1.1 Socio-technical constellation

§5.1.1 has already made clear that the ecosystem will become more complex and blurred with the introduction of the new roles and actors. At this stage of the MaaS development, there is still a lot of uncertainty about the organisation of the ecosystem. In addition, several governmental authorities are engaged within the ecosystem. They all have certain tasks and roles in the organisation of the mobility system, but these are spread across several governments (Program manager hubs and smart mobility Amsterdam, 2022). As a result, the tasks, roles and responsibilities of both private and public actors are not yet clearly arranged, which creates a lack of clarity and confusion. There is therefore in the governance a need for clarity about the roles, tasks, and responsibilities in the ecosystem (Project manager innovation office Amsterdam, 2022; Independent MaaS consultant, 2022; Gemeente Amsterdam, 2021).

In §5.1.1, it was also made clear that collaboration is the most important factor for the development and success of MaaS. The success of MaaS does not depend on its technical operation but primarily on clear organisational structures and collaboration (Policy advisor innovative mobility VRA, 2022). Public and private actors cannot realise MaaS without each other, they need each other: this is why for governing MaaS platforms there must be a focus on collaborative governance models in which all interests of the participating actors must be represented (Independent MaaS consultant, 2022; Independent consultant working on MaaS, 2022). This adds to the belief of UPE that urban governance is not confined to governments and that private actors are of equal importance in governance processes for creating wealth. There is then a collaborative coalition needed that consists of public and private actors who collectively promote growth to accomplish common interests that benefit all (Feagin, 1987; Stone, 1993). The urban regime theory of UPE then adds to this by mentioning that the governing capacity and the efficiency of local governments depend on the collaboration with private actors and the combined resources of both public and private actors. Creating a coalition of public-private collaboration is then thus an integral part of the governing process and is essential for the development and implementation of MaaS. But to date, collaboration is one of the biggest obstacles of MaaS. Because currently, the collaboration between the actors in the ecosystem does not (automatically) emerge, and the operators operate independently of each other (MaaS strategist Amsterdam, 2022). With the growing complexity of the ecosystem, it is becoming increasingly difficult to achieve collaboration (Program manager hubs and smart mobility Amsterdam, 2022; Project manager Smart and shared mobility and MaaS, 2022). The actors are difficult

to connect to each other and do not (yet) see the benefits of working together. This is partly because the MaaS platforms and actors have limited market power and user engagement at this stage of development. The added value of collaboration is therefore deemed minimal for many actors. Besides, many actors in the ecosystem currently distrust each other. There is namely a lack of transparency in the ecosystem, partly because of the unclear roles and responsibilities. This is why there is a need to work on a trust mechanism in which all actors jointly make agreements and draw up a vision everyone supports (Independent MaaS consultant, 2022). This also establishes mutual trust. And without transparency and trust, there will be no collaboration (Transport researcher, 2022, Project manager innovation office Amsterdam, 2022).

If the actors themselves do not initiate the collaboration, and the government wants the actors in the ecosystem to collaborate, then the government will have to facilitate the collaboration by exercising control (Policy advisor innovative mobility VRA, 2022). Governments can do this by establishing certain requirements that must be abided by the actors in the ecosystem, such as requiring standards or conditions in concessions and permits. It would be desirable for the government to lay down a framework for collaboration (MaaS Alliance, 2021). This way, the government takes a more regulating and dominant role in the ecosystem (Project manager Smart and shared mobility and MaaS, 2022).

Additionally, another barrier that currently occurs regarding the collaboration concerns the resale and reference products of transport operators. Transport operators would like to offer not only their own means of transport, but also other means, from other providers. Therefore, there is a desire for operators to resell each other's products (Project manager Smart and shared mobility and MaaS, 2022; Workshop 2, 2022). Besides, MaaS operators also need access to the products of other transport operators in order to provide integral mobility to travellers. But currently, PT operators only want to offer their products for resale at full tariffs (Workshop 1, 2022). MaaS operators will not be able to compete with this. And as a result, the development of MaaS will be held up. The access to products for integral mobility provision is not only in the interest of the platform operators, but it also affects the public interest. If transport operators do not offer their services to others or to platform operators, apart from holding up the development of MaaS, there is a possibility of price increases for travellers, the interoperability is severely difficult to achieve, and the usability for travellers may be obstructed (Workshop 2, 2022).

6.1.2 Data and its value

In §5.2.2, the most significant governance implication concerning data has already shortly been introduced. This namely regards the data asymmetry. It is about the data being in the hands of the mobility operators, who are fiercely resistant to sharing their data, as this puts them in a powerful position and provides a comparative advantage (Ministerie van Infrastructuur en Waterstaat, 2020). Therefore, private actors are not willing to share their data, while governments require this data to gain insights into the mobility system and to be able to manage the mobility system (MaaS strategist Amsterdam, 2022). The lack of access to data then also complicates the steering, monitoring, and influencing of behaviour to optimise the mobility system (Municipality of Amsterdam, 2022). Without access to the data, it is also more difficult for the municipality to protect and/or realise the societal goals and public values. Here too, therefore, collaboration between actors and the creation of an open, transparent, and healthy ecosystem in which the actors can trust each other is essential (Transport researcher, 2022; Ministerie van Infrastructuur en Waterstaat, 2020).
To gain access to the data, agreements must be made with the operators about how the data exchange can be organised. This will require the creation of a trust mechanism so that parties can learn to understand each other, trust each other, and collaborate (Ministerie van Infrastructuur en Waterstaat

2020; Transport researcher, 2022). And to receive data, the authorities will have to place themselves in the data infrastructure. This corresponds with the municipality's goal to incrementally position itself in the data infrastructure to make mobility smarter, more efficient, more transparent, and more innovative, as mentioned in §4.2 (Amsterdam Metropolitan Area, 2021). The authorities can place themselves in the data infrastructure by imposing certain requirements and conditions in the permits, concessions, and exemptions, and by developing and imposing technical standards that transport operators must comply with if they want to offer their services in Amsterdam (Program manager hubs and smart mobility Amsterdam, 2022). If the operators do not share data, the government can use its instruments to enforce access to data. The operators namely depend on permits from the municipalities to operate locally (Program manager hubs and smart mobility Amsterdam, 2022). The governments can include certain conditions on the sharing of mobility data in the permits, concessions, and exemptions with mobility operators, which is increasingly being done with new permits (Gemeente Amsterdam, 2021). In this way, municipalities can still acquire access to the data:

> "*If parties want to make use of the space that is managed by the municipality, then they <the operators> will have to share data. Otherwise, the municipality will not grant them permission to operate in the public space. You can only actively steer the public space and the use of the mobility system when you have that data.*"
>
> Personal communication, Program manager hubs and smart mobility Amsterdam (2022)

However, from a legal perspective, the government cannot demand just anything from private actors. The municipality may only make demands about data when this is done in the context of the management of public space, safety, and enforcement. If the requirements cannot be substantiated in local legislation, the municipality may not demand it (Workshop 2). This is partly why it is easier to impose requirements and conditions on transport operators active in public space. It is more difficult to enforce on MaaS operators that are not physically present in public space and are not under a municipal contract (MaaS strategist Amsterdam, 2022; Policy advisor innovative mobility VRA, 2022). Therefore, a legal foundation is always needed to collect data, which remains a permanent challenge for governments (workshop 2, 2022).

And as previously mentioned, governments can also develop and impose technical standards that the transport operator needs to comply with. Making a technical standard compulsory would allow all actors to work together unambiguously and on the same wavelength. The government must facilitate the creation of these standards to provide guidelines for the ecosystem to develop and promote collaboration (Project manager innovation office Amsterdam, 2022). In the Netherlands, the TOMP API (Transport Operator to Mobility Provider-Application Programming Interface) standard was developed to promote data sharing and facilitate more supply (Workshop 2, 2022). Such standards ensure that everyone speaks the same language (Project manager Smart and shared mobility and MaaS, 2022).

In addition, the data organisation regarding data sharing, storage, management, analysing, processing, and distribution is not yet sufficiently organised. It would be desirable to organise the data coordination in a centrally managed and secure database (Vervoerregio Amsterdam, 2021). In this, it is preferable that the organisation is arranged on a National or even European scale (Project manager innovation office Amsterdam, 2022). It is preferable not to structure the organisation regionally or locally, as transport providers would then have to offer their services differently for each area, which is deemed unattractive. The creation of a local or regional standard can also discourage providers from investing or implementing in certain areas (Workshop 2, 2022; Program manager hubs and smart mobility Amsterdam, 2022). In addition, there is often not enough knowledge, expertise, experience, and capacity

at the local level to arrange the data organisation (Consultant Smart mobility platform MRA, 2022). And the national or even European data organisation would also be conducive to data security and privacy (Workshop 2, 2022).

The last governance implication regarding data concerns privacy, as from a privacy perspective data cannot and may not be shared freely between actors. Those who collect data are responsible for the privacy of the concerned data. Data can in that way be a liability. The moment an actor possesses data, there is the risk that it will end up on the street (MaaS strategist Amsterdam, 2022). The government therefore has the obligation to protect the consumer. To this end, Europe has set up the General Data Protecting Regulation, which has been implemented in the Netherlands via the AVG. MaaS platforms and the connected services and operators must therefore be designed to ensure consumer protection and privacy, according to the AVG (Ministerie van Infrastructuur en Waterstaat 2020, Vervoerregio Amsterdam, 2021). To ensure privacy, it is therefore desirable that the collection and storage of data take place at a national level. This way, privacy can be centrally collected, organised, and managed (Project manager Smart and shared mobility and MaaS, 2022).

6.1.3 Spatial arrangements

The current mobility system and public space are not yet designed for how mobility is wished to be organised. But the effectiveness and success of MaaS depend on the adaptability of the physical space. This is because the physical space must grow along with what is made possible digitally (Independent MaaS consultant, 2022). The temporal dimension here forms a governance implication for municipalities. The mobility systems and infrastructure are rigid, and it takes a long time to adapt to change. This causes the physical space not to be sufficiently prepared for the transition MaaS will contribute to (Kennisinstituut voor Mobiliteitsbeleid, 2019; Independent MaaS consultant, 2022). This is because MaaS and its platforms develop faster than the municipality can adapt its rules, laws and public space (Independent MaaS consultant, 2022). In the short term, the municipality cannot keep up with the disruptions that MaaS causes. This may hold back the rapid development and implementation of MaaS, making the temporal dimension a possible barrier.

In the relationship between MaaS and physical space, too, collaboration between actors and the creation of an open, transparent, and fair ecosystem is important. This is because the municipalities want to pursue and safeguard all kinds of public values that the private actors do not take up themselves as it is not deemed profitable to do so. By collaborating with other actors, agreements can be made about inclusiveness, the distribution of transport throughout the city for a geographically comprehensive service, and the degree of sustainability of the vehicles. The municipality must therefore take the initiative and mobilise resources if necessary (Project manager Smart and shared mobility and MaaS, 2022).

6.1.4 Legislation and regulation

One of the most important governance implications concerns the compartmentalised organisation of mobility, which is prevalent on all government levels. Currently, there is considerable compartmentalisation in the law in terms of tasks, roles, and responsibilities between all modalities, as can be seen in tables 5.1 and 5.2. As a result, the modalities (PT, privately owned cars, and taxis) are all controlled, regulated and managed independently of each other (Policy advisor innovative mobility VRA, 2022; Vervoerregio Amsterdam, 2021). This means that the legislation is not interoperable and that the mobility system cannot be approached integrally (Consultant Smart mobility platform MRA, 2022; MaaS strategist Amsterdam, 2022; Workshop 1, 2022).

Because of the compartmentalisation, there are separate organisations, employees and capacities at all governmental levels operating isolated from each other. However, this organisation at the legal, organisational, and judicial levels results from historical organisations, establishing a certain governance. But it is not at all in line with the mobility system that is wished to be created with MaaS (Workshop 1, 2022). This compartmentalised organisation and the various responsibilities within the governments increase the complexity of the ecosystem for the governments themselves and for the other actors (Project manager innovation office Amsterdam, 2022), and this policy fragmentation hinders growth (Vervoerregio Amsterdam, 2021). Therefore, the governance should be altered and no longer be modality-oriented, but governments should organise mobility in a decompartmentalised and integrated way that creates clarity and uniformity (Consultant Smart mobility platform MRA, 2022; Vervoerregio Amsterdam, 2021). This is why one of the most important tasks is that the legislation (the Passenger Transport Act) should be adapted and decompartmentalised, which will be done in the upcoming years with the revision of the passenger transport act (Consultant Smart mobility platform MRA, 2022; MaaS strategist Amsterdam, 2022; Workshop 2). This not only provides more clarity about the tasks, roles, and responsibilities of the public actors, but also ensures that mobility can be managed more intelligently and efficiently.

Besides the completely compartmentalised organisation of current modalities in the legislation, there is currently no provision for shared mobility in the mobility organisation of governments (Consultant Smart mobility platform MRA, 2022; Independent MaaS consultant, 2022). This is not yet included in the national legislation, which means that the responsibility for shared mobility currently lies with the municipalities because the municipalities are in charge of permits and public space as road authorities, based on which shared mobility is now allowed. Thus, no generic agreements have been made at the national level regarding the organisation, which means that the organisation of shared mobility can differ per municipality (Workshop 1, 2022). When mobility is then organised on a municipal level, with which the organisation, interchangeability and connection of mobility can differ between different municipalities, travel becomes unattractive for travellers (Workshop 1, 2022). This is why it is desirable to organise shared mobility on a national level in legislation. This is currently being worked on, with the revision of the current Passenger Transport Act (Workshop 1, 2022; Workshop 2; 2022).

In addition, national and local policies make it convenient to use the car and provide fiscal incentives for leasing cars. As a result, people are often car-bound, which creates problems for the liveability and sustainability (Policy advisor innovative mobility VRA, 2022; Vervoerregio Amsterdam, 2021). The policies and the fiscal system now form an obstacle and must therefore be adapted to stimulate the use of MaaS and alternative transport by making the alternatives more accessible, or the policies and fiscal systems can be deployed to stimulate MaaS (Workshop 1, 2022; Independent consultant working on MaaS, 2022; Vervoerregio Amsterdam, 2021).

Legislation and policy are now primarily constraining factors, but when used optimally, legislation and policy can also be beneficial for the development of MaaS. For this, legislation and policy should be adapted and organised more clearly. Currently, not much is possible in the regulatory field of MaaS because it has not yet been included in legislation and/or policy. As a result, governments are consciously or unconsciously blocking certain developments with their regulations. This needs to change for MaaS to reach its full potential (Policy advisor innovative mobility VRA, 2022; MaaS strategist Amsterdam, 2022). But because of the innovative and dynamic character of MaaS, the policies and legislation need to be designed in a proactive, flexible, and adaptive manner so that when necessary, it is possible to adapt them. This is how the greatest contribution to social goals can be made (TNO, 2020).

6.2 Governance models

6.2.1 Models

It has been made clear that for the development and implementation of MaaS a new way of governing is required. The regional transport authority of Amsterdam (2021) has described several sub-models for developing MaaS, building on the three market models as described by Smith et al. (2018b) and Arias-Molinares and García-Palomares (2020) in §2.3.2. These sub-models within the fully private model, the fully public model, and the mixed private-public model are explained as follows:

- Fully private model: there are 2 sub-models in the fully private model, which are 'the winner takes all' and 'the dominant PT operator'. In 'the winner takes all' sub-model, actors operate in an open market in full competition, where eventually one actor will take the lead and dominate in the market. There is here no government interference. In the 'dominant PT operator' sub-model, the strength of the dominant PT operator is used to broaden the PT product with additional services such as car sharing, shared bicycles etc.
- Fully public model: in the fully public model, no specific sub-models have been developed.
- Mixed private-public model: in the mixed model there are 2 sub-models: 'government develops MaaS platform' and 'government develops standards'. In sub-model 'government develops MaaS platform', the platform is in government hands and mobility providers can use it. The MaaS apps running on it are not necessarily in government hands, but the uniform connection of providers is arranged. By developing and managing the platform itself as a government, a certain stability is offered, and there is relatively little disruption in terms of data and ease of use when there are changes in providers. But the power of innovation is limited. In sub-model 'government developed standards', the MaaS platform(s) are not owned by the government, but the government determines the technical codes and standards. Only for relevant purposes does the government have access to the information from the platform.

The fully private models are seen as undesirable for the development of MaaS. The private models, where one or a few private actors determine the market, are undesirable from the point of view of realising and protecting the societal goals and public values that MaaS is intended to achieve (Policy advisor innovative mobility VRA, 2022). The reason for this is that in fully private models, there is no government intervention (Vervoerregio Amsterdam, 2021), which means there is no or minimal control over the protection of public values. This could mean that MaaS may not be able to contribute to the realisation of policy goals, and may even go against them:

> "*Those private actors are never going to do all the public goals, certainly not to the extent that governments want. They aim for revenue maximisation and not policy goals.*"
>
> Personal communication, Project manager Smart and shared mobility and MaaS (2022)

This is highly undesirable, given that the purpose of MaaS is specifically to optimise the mobility system and achieve set goals. In addition, competition and the level playing field may also be restricted, as this conflicts with the business model of the monopolists. This is contrary to an open, transparent, and healthy ecosystem

However, a fully public model is not considered desirable or feasible either. In this model, the government must be the commissioner of all transport services. Organising this would require a significantly larger and longer-lasting government effort, it would demand a heavier workload from the governments, and it would require structurally high expenditure on all forms of mobility (Policy advisor innovative mobility VRA, 2022; Contract manager MaaS Amsterdam, 2022; Workshop 2, 2022). In addition, this model is extremely market distorting and limits market innovation (Vervoerregio

Amsterdam, 2021). However, this public governance model does offer the greatest guarantee for achieving societal and policy goals:

> "*Developing an own municipal app would be good for pursuing public goals and values. The municipality can set it up exactly as needed to achieve our goals. But then you are also responsible for the algorithms and assessment frameworks, which requires a lot of effort and a specific dedicated organisation.*"
>
> Personal communication, Contract manager MaaS Amsterdam (2022)

The government does not have the political will, capacity, or financial means to maintain this model. The governance of MaaS in a public model can therefore be excluded (Policy advisor innovative mobility VRA, 2022).

For this reason, there is a preference in the Netherlands for a mixed governance model with a public-private partnership, as mentioned in §5.1.1. In doing so, the Netherlands differs from other countries, and this unique approach requires a new steering model. This requires a different mindset that is integral and takes the new aspects and developments into account that are part of MaaS, such as the data and the ecosystem (Ministry of Infrastructure and Water Management, 2020). In the public-private partnership of the mixed governance model, the government works with transport operators, MaaS operators and other private actors (TNO, 2020). Central to this cooperation are several principles concerning collaboration, data sharing, standards, a level playing field and learning about MaaS and its impact on the mobility system (Ministry of Infrastructure and the Environment, 2020).
Based on the objectives and preconditions that governments have, the specific 'government develops standards' model is considered the most promising for MaaS in The Netherlands. This model is the only one that meets the social conditions set, but it does not contribute the most to policy objectives. In this model, the government provides a platform based on several rules and guarantees. Governments can then develop standards and use data to steer the mobility system to distribute the use of road networks more evenly, stimulate alternatives for privately owned mobility, manage congestion and use space more efficiently. The government can also manage the entry of new actors, by which they facilitate fair competition and level playing field (Vervoerregio Amsterdam, 2021).

However, choosing the appropriate governance model remains difficult, as there is little experience with the consequences of governance models in mobility systems with MaaS, and it is so context-dependent and there is no 'one size fits all' model (Project manager innovation office Amsterdam, 2022). The suitable governance model therefore depends on what the municipality aspires and which objectives the municipality wants to achieve (Project manager Smart and shared mobility and MaaS, 2022). In the Netherlands, the government attaches great value to societal goals, which is also the main reason for choosing the mixed governance model where the government can steer towards policy goals (MuConsult, 2017):

> *"The public authorities should be equipped with the necessary tools for governing the development of a multimodal mobility ecosystem and ensuring its compliance with public policy goals such as connectivity, accessibility, equity, and environmental benefits. It must bring benefits to society, the environment, and the users."*
>
> MaaS Alliance (2021, p. 5)

Regardless of the composition of the governance model, the government wants to be involved in the governance of MaaS. They want to participate to protect public values and ensure a level playing field

and an open and healthy ecosystem. By being part of the governance model, the government strives to minimise negative effects and wants to stay on top of things (Capgemini, 2021). To set up MaaS and facilitate public-private collaboration, the government will have to take greater ownership over the development process (MaaS strategist Amsterdam, 2022):

> "*We as public actors need to take many more steps and take an active role in directing the development of MaaS if we want to reach the objectives we envision with developing MaaS*."
>
> Personal communication, Project manager Smart and shared mobility and MaaS (2022)

By playing a significant role in the early stages of the development, the government can determine what MaaS will look like and contribute to optimising the mobility system. But once MaaS has been implemented and stabilised, the government can step back from direct involvement.

6.2.2 Collaborative agreement system

With the choice for the public-private mixed governance model, a choice is also made for a collaborative governance model. The public and private actors will have to work together, trust each other and be transparent. But this is proved to be difficult with so many actors in the ecosystem. At present, the actors in the ecosystem do not understand each other and give each other little space (Transport Researcher, 2022). It is therefore of great importance that the governance framework is drawn up in which all actors participate and collaborate, and in which the interests of all actors are represented (Independent MaaS consultant, 2022):

> "*The actors must jointly make plans and agreements that everyone can support, in order to motivate them to work towards common goals, and to set up a model that everyone can benefit from*."
>
> Personal communication, Transport researcher (2022)

Here, the trust of the ecosystem is the basis for the development of the mixed governance model because all actors are each other's partner and competitor. The governments are therefore taking initiatives to increase trust, such as building a trust mechanism. To promote collaboration and create an open and transparent ecosystem, the MaaS lab and an agreement system (the afsprakenstelsel) were set up. Here, actors make agreements among each other in targeted working groups:

> "*The agreement system (afsprakenstelsel) can help clarify the relationship between public and private actors, by making agreements that apply to everyone and that everyone supports*."
>
> Personal communication, Independent MaaS consultant (2022)

Currently, the MaaS Lab and the Ministry of Infrastructure and Water Management are working out the standard rules and principles, so that those can serve as the underlying structure for MaaS which will contribute to organizing the MaaS services more efficiently.

6.2.3 Phased involvement

In the previous chapters, in §6.1 and this paragraph, it has been mentioned several times that a larger or more dominant role is seen for the governmental actors in the governance of MaaS, for example in facilitating the public-private partnership, data sharing, designing the physical public space, the contributions and protection of the societal goals and public values and more.

However, the degree of government involvement and dominance strongly depends on the phases of the MaaS development. The relationship between public and private collaboration, and the role of the government, is different in each development phase:

> *"All the different phases probably need a different type of collaboration construction when it comes to public and private actors, and it's not that you can say there is a fixed proportion, because it depends on the different dimensions of the governance model, how you organize it. So, the collaboration could be balanced different at different levels."*
>
> Personal communication, Transport researcher and Consultant urban systems (2022)

The close involvement of governments is seen as imperative, particularly in the early stages of MaaS development. The governments are then facilitators, setting the frameworks and making agreements to develop MaaS, creating a level playing field and an open, transparent, and healthy ecosystem. In this way, the municipalities help set up and implement MaaS by taking on a director's role (Program manager hubs and smart mobility Amsterdam, 2022). And when MaaS is further developed and stabilised, the governments can slowly phase out and adopt a less heavy and dominant role (Vervoerregio Amsterdam, 2021). The mixed governance model thus does not require a long-term commitment from the government, and the government does not need to take on any new governmental tasks, and thus the model also remains affordable (Vervoerregio Amsterdam, 2021).

6.3 Public/societal interests

With the development and implementation of MaaS, the municipality wants to work on social goals in cooperation with other governmental actors. The main goals for Amsterdam are to create a more space-efficient mobility system and a car-free city in which travelling by non-owned vehicles is easier and more self-evident, and which creates less ownership and more space (Policy advisor innovative mobility VRA, 2022; Program manager hubs and smart mobility Amsterdam, 2022):

> *"Specifically, with MaaS Amsterdam wants to focus on a liveable city in which the car is less dominant, and people can move around more easily with an alternative form of mobility. This will create a clean and safe mobility system with efficient use of space."*
>
> Personal communication, MaaS strategist Amsterdam (2022)

In addition, several goals are mentioned, such as accelerating the transition to an emission-free, clean, and sustainable mobility system, creating a system that is accessible and inclusive, deploying shared transport, and steering for liveability, safety, and accessibility (Ministerie van Infrastructuur en Waterstaat, 2020). MaaS is often seen as the solution to everything, but it is not possible to solve all (mobility) problems by implementing MaaS (Project manager innovation office Amsterdam, 2022). MaaS can be used as a tool to achieve social goals and values, but not all goals should become a promise of MaaS, as MaaS is not a holy grail (Program manager hubs and smart mobility Amsterdam, 2022).
In this chapter it has already been mentioned that in order to steer towards the social goals, the municipality and the other governmental organisations will have to take more control of MaaS and greater ownership over the development process. The governments will then have to enter into collaborative relationships with private actors, agreeing on how to jointly work on the public values. If the government does not manage this (enough), these public values will not be protected or achieved, as the private actors prioritize profit maximization over the realisation of societal goals (Project manager Smart and shared mobility and MaaS, 2022). The public values are then too valuable to leave entirely to the market (Ministerie van Infrastructuur en Waterstaat, 2020). So, when the government wants to protect and achieve certain public values, they must also contribute (financially) to this (Consultant

Smart mobility platform MRA, 2022). They can take a passive or active role in this, whereby they can coordinate or make far-reaching interventions to protect those public interests (Consultant urban systems, 2022; Transport researcher, 2022).

It is desirable for Amsterdam to integrate social values and policy as much as possible with MaaS (Project manager innovation office Amsterdam, 2022). As mentioned in chapter 4, the municipality aims to achieve integration level 4 as described earlier in Sochor's et al., model (2018), which requires a close cooperation and far-reaching transparency from all actors involved (Ministerie van Infrastructuur en Waterstaat, 2020; Consultant Smart mobility platform MRA, 2022, MaaS strategist Amsterdam, 2022). This integration is very important for the social success and added value of MaaS, but before committing to this integration, the most important thing is to implement MaaS and let it become a mainstream service (Program manager hubs and smart mobility Amsterdam, 2022)

For the protection and realisation of the societal goals and public values, it is then of great importance that the municipality makes maximum use of its instruments (MaaS strategist Amsterdam, 2022; Project manager innovation office Amsterdam, 2022; Vervoerregio Amsterdam, 2021). For example, governments can attach requirements to exemptions and permits. The authorities can then make certain agreements with providers, as is currently the case with concessions (Program manager hubs and smart mobility Amsterdam, 2022; Vervoerregio Amsterdam, 2021). In this way, the governments can impose conditions on the providers, causing them to partly pursue certain goals of societal interests (Project manager Smart and shared mobility and MaaS, 2022). In this way, governments can continue to exert influence and safeguard social interests and regulate the quality and behaviour of mobility services (Workshop 1, 2022; Vervoerregio Amsterdam, 2021).

6.4 Governance recommendations

In this paragraph, some key enablers are appointed, which can specifically contribute to good governance for MaaS from the perspective of the city of Amsterdam. These enablers are derived from the main findings of this research which have been discussed in chapter 5 and the previous paragraphs of chapter 6, and are subdivided according to the categories from the analytical framework, supplemented by several enablers based on the regulations, legislation and municipal instruments regarding the governance of the digital platforms.

Table 6.1: governance recommendations on municipal level

Socio-technical constellation	
1	Promote collaboration between the private and public actors of the ecosystem by establishing a framework for collaboration. The municipality should act as the matchmaker between public and private actors in order to foster public-private collaborations, by initiating negotiations in which agreements and plans are made collectively and where a jointly supported vision is created, so that the interest of all actors is represented, and everyone works towards the same goal. This is also deemed necessary for the creation of enough trust between actors. Without collaboration, services will not be integrated properly and MaaS cannot propose an attractive alternative.
2	A clear division of tasks, roles, and responsibilities should be apparent in the ecosystem. If the tasks and responsibilities are not clearly assigned, it is chaos for the actors and for the users. Therefore, the roles for both public and private sector actors should be allocated clearly. This will help in creating a healthy and transparent ecosystem, a fair level-playing field, and a solid base for collaboration between all actors.
Data and its value	
3	The municipality should invest in the creation of the data infrastructures, which then also can be used to set preconditions for the actors. Next to this, the municipality should increase their position in the data infrastructure by making arrangements, setting standards and possibly use their permits and concessions for enforcement, in order to actively manage the mobility system

Spatial arrangements	
4	The physical urban space should be adjusted, so that it reflects what the municipality wants to achieve with its mobility system and MaaS. The public space can then facilitate and ensure the transition towards MaaS. Herein also the mobility policies require adjustments to physically accommodate and integrate new mobility services. The adjustments of public space and the policies will then increase the accessibility and equitability of the mobility system.
Legislation, regulations and municipal instruments	
5	The modalities that are now organised separately and independently should be integrated in legislations and regulations. This should happen at the national, regional, and local level. This creates more clarity and unambiguity, making the organisation conducive to MaaS. And besides the integrating of the different modalities, shared mobility should be added to the legislations and regulations as well.
6	The municipality of Amsterdam should communicate and coordinate their policies with other (adjacent) municipalities so that MaaS and the mobility system are mutually exchangeable and interoperable.
7	The municipality should not try to integrate all societal goals in the development phase of MaaS. The priority should be on ensuring MaaS operates well and is being used. After MaaS is up and running, the societal goals can be integrated. Herein it should not be expected that MaaS will solve all mobility problems, as MaaS remains a tool that can help contribute but is not sufficient to achieve all the goals by itself.
8	The municipality should take the lead in this development phase of MaaS and should use its instruments and resources to get MaaS working. The municipality should however be considerate with using heavy regulatory instruments. The priority should be aimed at ensuring transparent market conditions, fair market performances, creating a level-playing field, safeguarding societal and policy goals. In this the municipality should make agreements with actors in which the private actors are given sufficient room to run a profitable business case.

Source: author

These recommendations are mainly focused on the perspective for the city of Amsterdam, but some do require joint adjustments and interventions with other government levels. This mainly concerns the national government, as they are ultimately the government with the most authority, are in charge of legislation and regulations and have the largest instrumentarium. With their power, the national government can be very decisive for the development of MaaS at the municipal level and the municipal possibilities in the governance of MaaS. But the municipality remains a powerful actor in the development of MaaS as well, as MaaS manifests itself on a local scale and the municipality remains the manager of the local level. So, the municipality should use their time, money, knowledge, and capacities as efficiently as possible to develop and implement MaaS.

6.5 Sub-conclusion

In this last results chapter, an answer was given to the third and last sub-research question:

> *Given these characteristics, how could municipalities govern MaaS to ensure public value & equitable access to mobility?*

This was firstly done by discussing the governance implications introduced by the distinctive elements of the MaaS processes. In the first paragraph there were multiple implications discussed which complicate the governance of MaaS, which have made clear that the governance of the mobility system requires a change to be able to organise the mobility.

- In the discussion on the socio-technical constellation, it became clear that the ecosystem will become more complex and blurred, and that the organisation of the ecosystem is still uncertain, which is in line with the findings of Ramirez (2016) and van der Graaf and Ballon (2019). It is unclear who will embody what roles, tasks, and responsibilities, which causes confusion and requires clarity and transparency. Docherty et al. (2018) add to this, as they mention this is the case since the platforms introduce new dimensions to the planning practices, which presents new challenges and affects the

governance due to the new constellation of actors in ecosystems and the lack of control and transparency. The collaboration is then essential for the development of MaaS but currently forms an obstacle since the collaboration does not emerge and actors operate independently. Therefore, there is a need for a trust mechanism in which actors can make joint agreements and visions. The creation of an open, honest, and transparent ecosystem is herein essential. If the collaboration fails to emerge, governments need to facilitate the collaboration by establishing requirements, standards, and conditions for private actors, and laying down a framework for collaboration.

- The section on data and its value showed that the main governance implication regarding data entails the data asymmetry, where the data is in the hands of mobility operators who do not want to share this data as this creates a comparative advantage for them, which coincides with the findings of Barns et al. (2017) and Hodson et al. (2021). However, to ensure the foreseen goals are reached, Barns (2018) mentions that the sharing of data is necessary, which this research adds to. Governments namely require the data to get insights into the mobility system, and to manage, control and steer the mobility system. This also complicates making the mobility system more efficient, and it complicates the protection of societal goals and public values. Here then too the collaboration between actors and an open, transparent, and healthy ecosystem is essential. The governments then need to place themselves in the data infrastructure, which they can do by inserting requirements and conditions in permits and concessions, as the operators depend on these to operate. Or the governments can obligate the application of certain (technical) standards. Goldsmith and Crawford (2014) and Barns (2018) then add to this by stating that by using the data, there is great potential to revitalise and transform the governance of cities, which can help in addressing the challenges of cities. Next, the data organisation is not yet sufficiently organised, which requires data organisation to be adjusted, preferably in a centrally managed and secured database. Lastly, the privacy of travellers' data must be considered, for which it is desired to organise the collection and storage of travellers' data on a national level.
- The discussion on the public space then clarified that the mobility system and urban space are inextricably connected, like is the case in PU according to van den Hurk et al. (2021) and Fields et al. (2020). Due to their entanglement, the platforms like MaaS continuously create adjustments in new forms of the urban space. But the space and the mobility system are not designed for how the mobility is wished to be organised. The urban space can namely not develop as fast as MaaS is developing, causing the spatial design to lag behind, this adds to the findings of Lee et al. (2020) concerning the transformations of urban infrastructures caused by platforms. By collaborating, agreements can be made about the physical space and inclusiveness and accessibility, creating a geographical comprehensive service and sustainability.
- Lastly, the part on regulation and legislation revealed that one of the most important governance implications concerns the compartmentalised organisation of mobility, which means that legislation is not interoperable and that the mobility system cannot be approached integrally. The governance should therefore be altered and decompartmentalised, and integrated to create clarity and uniformity. Besides, currently is the provision of shared mobility not integrated into national legislation and organisation. It is desirable to organise the organisation of shared mobility on a national level in legislation and ingrate this with the modalities. Lastly, the legislation and regulations favour the use of privately owned and leased cars by providing fiscal incentives, which forms a barrier to the use of MaaS.

The introduction of the platforms and the implications these entails change the way mobility is organised which requires the governance models and organisation frameworks to evolve. PU then requires the governance to change in a disruptive manner. This finding of Barns (2018) and Arup (2014) is validated

in this study. According to Audouin & Finger (2018) and Smith (2020), it however remains unclear what the governance should look like. This research adds to this knowledge gap by researching how the governance could and should look in the Netherlands. There are several possible governance 'models' for steering MaaS. The Netherlands is convinced that a collaborative governance model is needed for the development of MaaS, and has therefore chosen a public-private model in which governments work together with transport and MaaS operators and other private actors. Specifically, the governance model 'government develops standards' is considered the most promising for MaaS in the Netherlands. Herein can the municipality take on a facilitator role where the state collaborates with the ecosystem and uses limited interventions that can steer the development of MaaS, which allows the government to monitor a healthy ecosystem and protect and stimulate social goals. This then adds to the article of Sørensen and Torfing (2009) on the different possible roles and interventions of the governmental actors.
To apply this collaborative governance model to steer mobility and facilitate MaaS, the municipality will have to take more ownership of the development process. This adds to the article of Lee et al. (2020), stating that the public actors would have to play a more active role in managing the process. It remains difficult to indicate a successful model as there is 'no one size fits all', but the municipality will have to take on a role, in which the question is how far it will go. This adds to the report of EMTA (2019), stating that without the governments involvement, it is unlikely that the mobility system can be replaced. Herein, the degree of government involvement and dominance is dependent on the phases of development, whereby the government will be more intrusive and present to shape the development in the beginning and will take more distance further in the process.

The public values and social interests are considered very important by Amsterdam. The aim is to integrate social values and policy as much as possible with MaaS to achieve maximum integration. From the interest of public values, the municipality therefore tries to link many goals to the development of MaaS, while it must be recognised that MaaS cannot solve all mobility problems and achieve all transport-related goals. Here again, it is clear that the municipality must take more control to protect public interests, where leaving it to private actors is a risk since the platforms have differing priorities and often have no interest in safeguarding public values, which concurs with the findings of Lee et al. (2020) and Riemens et al. (2021). It is important here that the municipality makes maximum use of its instrumentarium to protect societal and public values, but it should consider the survival of the business models of private actors here too. To protect and accomplish societal goals and to include MaaS in the city plans, the municipality will have to adjust its mobility policy and accompanying policies, which is in alignment with the findings of Docherty et al. (2018).

7. Conclusion

In this chapter first and foremost, the main research question of this study shall be answered. Afterwards, this chapter shall discuss the theoretical implications, the reflection and limitations of this research, some recommendations for further research and the social implications.

7.1 Answer main question

It has become clear that there is a need for an adjustment of the current mobility systems due to mobility continuing to grow while it is reaching its limits and other varying problems experienced in the current mobility system. This is where MaaS is believed to be a potential solution to (part of the) experienced problems. But the introduction of MaaS demands that the use and organisation of mobility as it is at present has to be fundamentally transformed and reorganised. MaaS namely is believed to have a profound impact on the mobility systems due to its innovative organisation that contains elements that are not known in the current mobility systems. These elements concern the ecosystem, the digital and material aspects, the role and value of data, and the spatial arrangements.

But as the introduction of MaaS changes not only the mobility system but also the governance hereof, this research analysed what the introduction of MaaS means for the governance of Amsterdam's mobility system. The city of Amsterdam served herein as a case study and provided the context in which the study object has been analysed since the governance of MaaS is such a context-dependent subject. This research was then conducted by analysing data retrieved from a document analysis, stakeholder workshops, and expert interviews. These methods were selected to answer the main research question:

What does MaaS mean for the governance of Amsterdam's mobility system?

The answer to this main research question is threefold. Firstly, it has become clear that Amsterdam has formulated various goals that it wishes to achieve with MaaS. Generally, the goal of MaaS is to make mobility more user-friendly by putting the user central and to establish a more efficient mobility system. But besides these general goals, Amsterdam has drafted additional and more specific goals. With the various goals MaaS has drafted, Amsterdam specifically aims to reach the fourth level of integration, where societal interests and values are combined and integrated with policies. These specific goals centre around the eventual aim to make the city more liveable and attractive by reducing the use of privately owned cars and by facilitating and stimulating the transition towards a more (space) efficient, clean, high quality, accessible and inclusive, multimodal, and sustainable mobility system. MaaS should herein be seen as a facilitating part of the transition that will change the mobility system. But in order to contribute to achieving these goals, the mobility system and its governance will have to change.

Secondly, the introduction of MaaS changes the mobility system, as it introduces new elements in the mobility organisation. These new elements and their influence concern the following:

- Socio-technical constellation: the introduction of MaaS brings new roles, tasks, responsibilities, and relationships, causing the ecosystem to become severely complex and blurred. The collaboration between all actors within the ecosystem and the realisation of an open, fair, healthy ecosystem and a level playing field are then important. Besides this, the digital infrastructure, technical development and technical interoperability are crucial for the operation of MaaS, as MaaS is a digital platform that relies on technical functioning.
- Data and its valuation: data forms the most valuable commodity in MaaS. It serves as the base for the business models for private actors, and it serves as a knowledge source for public actors who can gain insights into the mobility system and accordingly base their policies on the data. Data

occupies a central role in the operation of platforms, for which the capture, integration and sharing is then essential for optimal service provision. With this, the data changes the functioning of the mobility provision profoundly.
- Spatial arrangements: MaaS depends on physical infrastructures, space, and materials to function properly. But the physical space and MaaS influence each other. The development of MaaS influences the way public space is being organised, and the formation of public space influences the development of MaaS. The current formation of urban space does however not concur with the formation that matches MaaS. If the space is to contribute maximally to the success of MaaS, and thus to the societal goals it aims for, the spatial arrangements will have to be adapted accordingly.

These new elements are not yet known (to this extent) in the current mobility system and require a new way of governing the mobility system. These elements namely constitute governance implications for the current organisation of the mobility system. And if MaaS is to be implemented and used successfully whereby the social objectives are achieved, a new governance model should be developed.

Lastly, the main implications for the governance that were identified in this research per category are the following:
- Socio-technical constellation: there is uncertainty and unclarity about the roles and responsibilities of actors within the ecosystem due to its complexity. Besides, the collaboration is deemed essential but will not emerge by itself, which then complicates the creation of an open, honest, and transparent ecosystem. Additionally, technical development is still needed for the operationality of MaaS, wherein the digital infrastructure and interoperability still need to be realised, and the technical elements will then have to be integrated and must be interoperable with the material elements of the mobility system to be fully operational and efficient.
- Data: there is a data asymmetry wherein private actors possess the data as they collect it but are resistant to sharing this data with other (governmental) actors, as this is their capital accumulation that their business case relies on. The lack of data for governments means a lack of knowledge, which makes it more difficult to adjust the mobility system and improve the mobility service for the citizens. Here too then, an open and transparent ecosystem is required wherein the actors collaborate.
- Spatial arrangements: the space and MaaS are currently not matching, which requires the space to adapt. However, due to bureaucratic processes, the space cannot change as fast as MaaS develops, causing the spatial design to lag behind. With space lagging behind the development of MaaS, there is no equal accessibility. Besides, currently there is no equitable service yet, as the transport operators mainly operate in profitable areas, causing a distorted mobility offer throughout the city.
- Legislation and regulations: mobility organisation is currently compartmentalised, due to which mobility cannot be managed integrally. Additionally, as of now is shared mobility not incorporated into the national organisation of mobility, which makes it hard to manage shared mobility integrally within and between different municipalities.

Because of the stated objectives, the new elements, and their implications, new governance is required. The municipality and other governments seem to have difficulties with the governance of platforms and the platformisation trend because they have no experience with governing platforms (yet). Governments have experience and are skilled at regulating physical matters such as public space, but they still have to learn how to govern the digital domain that characterises platforms. There is herein no 'one size fits all' model that can be implemented since the governance of MaaS is highly context-dependent. The position taken in the governance by the governments is then a factor that will determine the design of the new governance. In this respect, the Netherlands is convinced of a collaborative governance model in which public actors work together with private actors to develop and implement MaaS. The

government actors consider this model attractive because it allows them to control the development process in order to ensure that an optimisation of the mobility system can take place. By entering into collaboration, the municipality can apply limited interventions to steer the development without too many far-reaching new tasks, roles, or responsibilities. The municipality must then take on a facilitating role, to ensure the protection and promotion of societal goals and public values, as this is seen as essential for the municipality.

The development of MaaS will require the municipality to take more ownership of the development process. But the involvement in the ecosystem and the intensity of the involvement varies per phase. The public actors see a more intrusive and present position for the municipality in the beginning of the process to shape the development to achieve the set societal and policy goals. But private actors also foresee a larger role for the municipality in the beginning to facilitate more clarity and transparency, and to stimulate the development. To achieve the goals set, the government will have to take on a facilitating role, taking more control of the governance. When there is a stable basis that fits the municipality's vision, the government can slowly disengage. When necessary, however, the government can remain present to further manage the development and implementation. The different levels of government have herein different functions and will have to coordinate their responsibilities and tasks to facilitate MaaS and stimulate the transition to the new mobility system.

7.2 Theoretical implications

While the academic literature on MaaS is growing, there remains a gap in the literature on the governance of MaaS. Next to this, there is a growing literature on case studies of MaaS, but herein are often the same case studies researched. This thesis attempted to contribute to the research gaps by gaining more insights into the influence of MaaS on the governance of mobility systems by conducting a specific case study on Amsterdam. This has also led to a better understanding of this context-dependent case study, which provides learning points for other cities or places with similar contextual characteristics who experience similar challenges. With this, this research has built on the research recommendation of Smith (2020) and Audouin (2019), who emphasised that more empirical research was needed that looks at cases where MaaS is applied that have been studied only to a limited extent or not at all, such as the case of Amsterdam. By studying Amsterdam, a better understanding of the governance of MaaS can then be obtained. Besides, Audouin (2019) also recommended that more research should be done on the governance of MaaS using other conceptual frameworks next to the more commonly used framework of the multi-level perspective. This research has addressed this recommendation by applying the framework of UPE and PU, which has not been done before in research on MaaS. This research has shown that UPE as theoretical approach and PU as research lens can serve as a starting point for the analysis of the introduction of MaaS in the mobility systems and its governance. By examining the implications of platforms in society in the case of MaaS, it becomes clearer how this affects governance and what the connected consequences are for the tasks, roles and responsibilities of governments.

Finally, from the results it becomes apparent that it is difficult to indicate exactly what the governance of MaaS should look like and what form it should assume. This is caused by the heterogeneous contextual nature of this research subject, wherein there is no 'one size fits all' governance model. This outcome is in line with other scholars' statements (Bouton et al., 2017; Lee et al., 2020; Hensher et al., 2020c, Caprotti et al., 2022; Repette et al., 2021). And due to the context dependence, there is also limited applicability of the outcomes to other places (Audouin & Finger, 2018; Audouin, 2019; Smith, 2020).

7.3 Reflection and limitations of the research

In retrospect, certain processes and aspects of this thesis could have been approached differently, which might have been more suitable for this research. Some limitations have already been discussed in the methods chapter, but some reflecting notes can be made about the research process and additional research limitations.

A first reflection and limitation concerns the execution of the research. The results and the conclusion of this research are namely based on the understandings and interpretation of the experts interviews and stakeholder workshops by only one researcher. Although the interviews were recorded, transcribed and quotes were sent back for a reaction, and the input out of the workshops has been checked and permission was requested, there remains a chance that the context is not entirely correctly understood. Since one researcher conducted the interviewees, the interpretation, and the analysis, it is debatable whether the outcomes obtained by other researchers would provide the same conclusions. The outcomes could possibly be biased, which would lower the reliability. The recommendation to circumvent this limitation is to adapt the research's design and to give several researchers the responsibility to interpretate the interview and workshop outcomes. However, during and after the interviews, verification questions were asked, and permission was requested for the inclusion of specific statements. Permission was also requested for the inclusion of input from the workshops. Overall, it can then be regarded that the interpretation by the researcher impacts the quality of the research to a limited to reasonable extent.

The second point of reflection refers to the methodological approach of this research. In this research, a relatively limited amount of perspectives was included in the interviews, as the ecosystem and the amount of different actors who are a part of the MaaS development is quite large. It would have been interesting to incorporate more perspectives and to interview more representatives of certain perspectives. The drawback of the research approach of this research is herein that there was a strong focus on governmental actors and policies. Therefore were the majority of the interviews conducted with experts who were active as public actors. But MaaS is also largely determined by private actors. Unfortunately, the transport and MaaS operators were not included in the scope of this research. As their role is essential in the development of MaaS, it would be interesting to interview them and get an insight into their views on the development and governance of MaaS. Next to this, the interviews were conducted with experts who represented public actors on local and regional levels. But it has become clear that the national government also occupies a key role in the development of MaaS. No interviews were conducted with representatives from the national government, which could have resulted in additional interesting findings. However, their perspectives were incorporated through the document analysis and more importantly, the stakeholder workshops. The recommendation to overcome these limitations is to interview more representatives of varying actors and to interview more experts per perspective. To conclude, given the focus of this research on the local level and the triangulation of research methods, it can be considered that the type and amount of interviewees impact the research quality to a limited extent.

The last research limitation refers to the stakeholder workshops. Initially, four stakeholder workshops would be conducted, each discussing a sub-topic central to this research. But due to changing plans, emerging priorities and cancellations, there have unfortunately been several postponements. As a result, two of the four workshops fell outside the time frame of this research. To compensate for the missing information, some extra questions were included in the expert interviews, and certain subjects (that were supposed to be included in the workshops) were questioned in more detail in the interviews. This way, it was attempted to cover the missing contribution of the workshops. Ideally, the remaining workshops would have been part of the data collection. However, by compensating for the cancellation of the

workshops by adapting the interview guide, all the necessary information was collected after all. The impact of the missing stakeholder workshops on the research quality and reliability has therefore remained limited.

7.4 Recommendations for further research

Among other things, the above-mentioned reflections and limitations call for recommendations for future academic research. First of which is to perform even more empirical research on other cases where MaaS is being developed and implemented to create a more holistic comprehension of the governance of developing MaaS. There are already several case studies, but these are focused on a limited number of cities and countries. As MaaS and the best way to govern MaaS are highly context-dependent, it would be valuable to learn how different cases and locations manage the development of MaaS. This adds to the knowledge of the efficacy of MaaS and the influence of the platformisation and thus digitalisation of mobility systems. In this way, more is learned in a broader context about how society adapts to new social trends and the transition to smart cities and smart urban governance. Moreover, the increase of case studies on MaaS will enable cities to learn from each other and hopefully help create an understanding of how to implement and govern MaaS successfully and easily. And while this thesis looked at what MaaS means for the governance of mobility systems, and what the city of Amsterdam can do in terms of governance to achieve its goals, there is still a strong demand for Amsterdam, but certainly also for other cities, on more knowledge about how cities can specifically adjust the governance on their mobility systems to be able to adopt and implement MaaS. This requires (even) more insight into how the public actors can shape and manage the development, diffusion, and use of MaaS, and how MaaS can be facilitated. The increase in the amount, but especially the variety, of case studies on MaaS can help provide more insight into this.

In the limitations of this research, it was already mentioned that the perspective of the private actors such as transport- and MaaS operators was not included, but this could provide interesting insights for the development of MaaS. It would therefore be recommended to use this research for further investigation into the perspectives of the private actors and their business models as their role is decisive for the development of MaaS, and therefore should also be considered in creating the governance model. Besides the private actors, it would also be suggested to incorporate the (potential) users of MaaS in research. Since MaaS puts the user at the centre, it is important how the user is included in the MaaS development process. After all, the success ultimately depends on the users of MaaS, and it would be good to include their perspectives in research on the development of MaaS.

A last recommendation for further research centres around the need for more empirical evidence on the efficacy of MaaS. As of now, MaaS mainly rests on assumptions. It is for example assumed that MaaS will be beneficial for mobility systems, and that MaaS will bring efficiency improvements. But there is no concrete evidence that confirms the assumptions. And how the different governance approaches can influence the uptake of MaaS remains a complex question, as the impact and changes that are brought on by this innovation remain uncertain. To better understand MaaS and its impacts on the existing mobility systems more research then needs to be done, as clear evidence still lacks. And seen MaaS is a fairly new and innovative concept, and the amount of research and available data is limited, the need for more research is endorsed.

7.5 Social implications

By examining how MaaS changes mobility processes and what this means for the governance of mobility systems, this research contributed to a better understanding of how MaaS can and should be governed. It created more insights into the possible roles of the local government herein. This

understanding can help Amsterdam specifically but also other cities in developing and implementing MaaS by creating insights into the changing mobility and governance hereof. The results show a need for more clarity and transparency in the entire ecosystem, in which a role is seen for the governments. Therefore, this research argues that the local, but also the regional and national governments should adopt a more prominent role in the developmental phase of MaaS. The authorities must herein use their instruments to shape the development so that it can contribute as much as possible to improve the liveability and quality of the city and so that the societal and public values can be protected. But by taking an active and prominent role, the government can and must also ensure the creation of an open, healthy and transparent ecosystem, which is necessary for the collaboration of the involved actors. The collaboration is then the basis for the development and integration of the mobility services, the sharing of the data, making of agreements on the use of public space and on the functioning of MaaS and creating a more efficient mobility system.

An essential part remains that in the development of MaaS, the user must remain central and that everything done is in the user's interest, as the primary goal of MaaS remains to provide mobility in an attractive, efficient and personalised way to the user.

The conclusions and outcomes of this research specifically relate and apply to the city of Amsterdam, as the case study and the contextual base of this research are herein limited to the case of Amsterdam. The outcomes do however add to the broader body of knowledge on MaaS and can (to lesser extent) provide useful insights for other cases.

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Appendices

A. Images

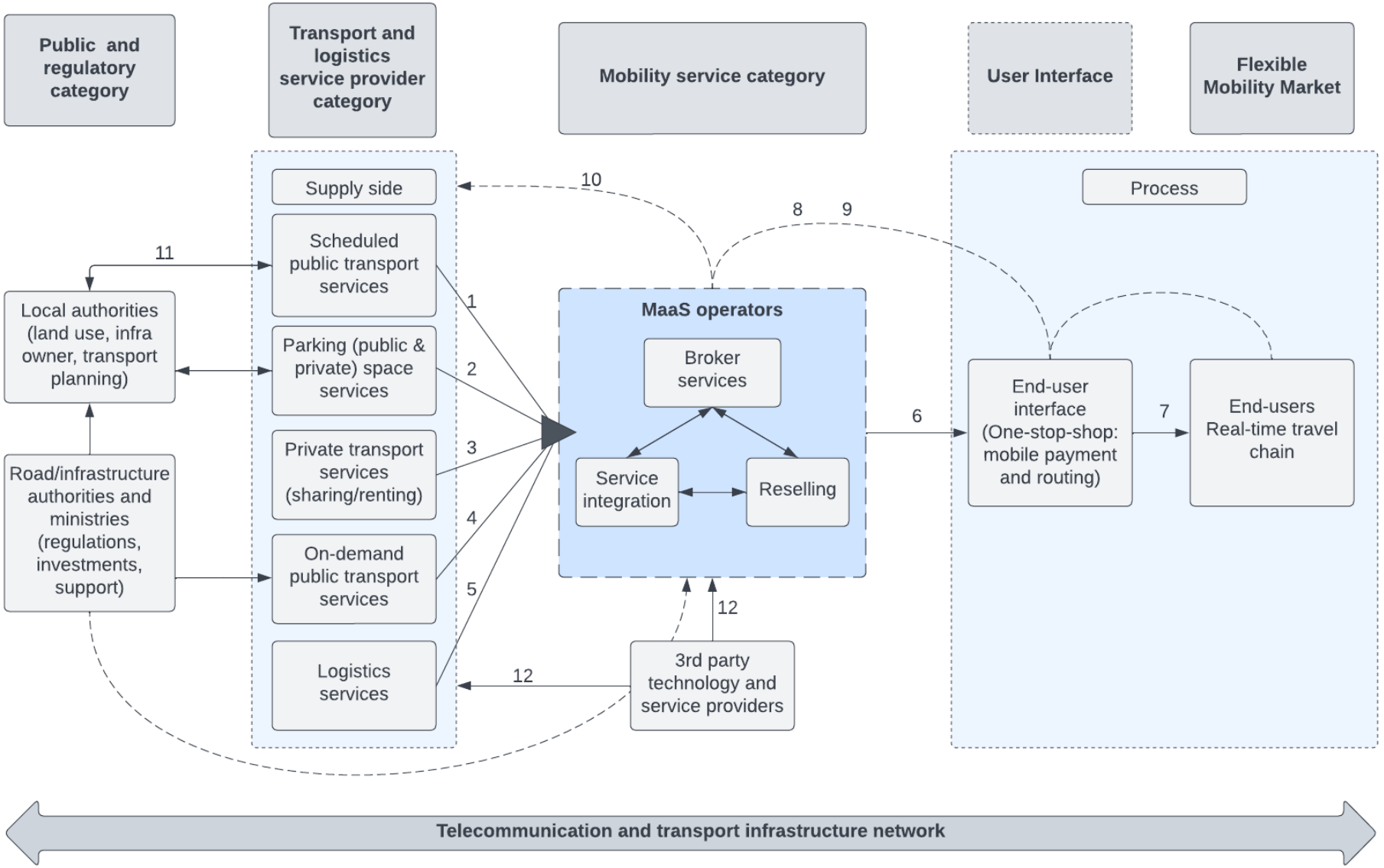
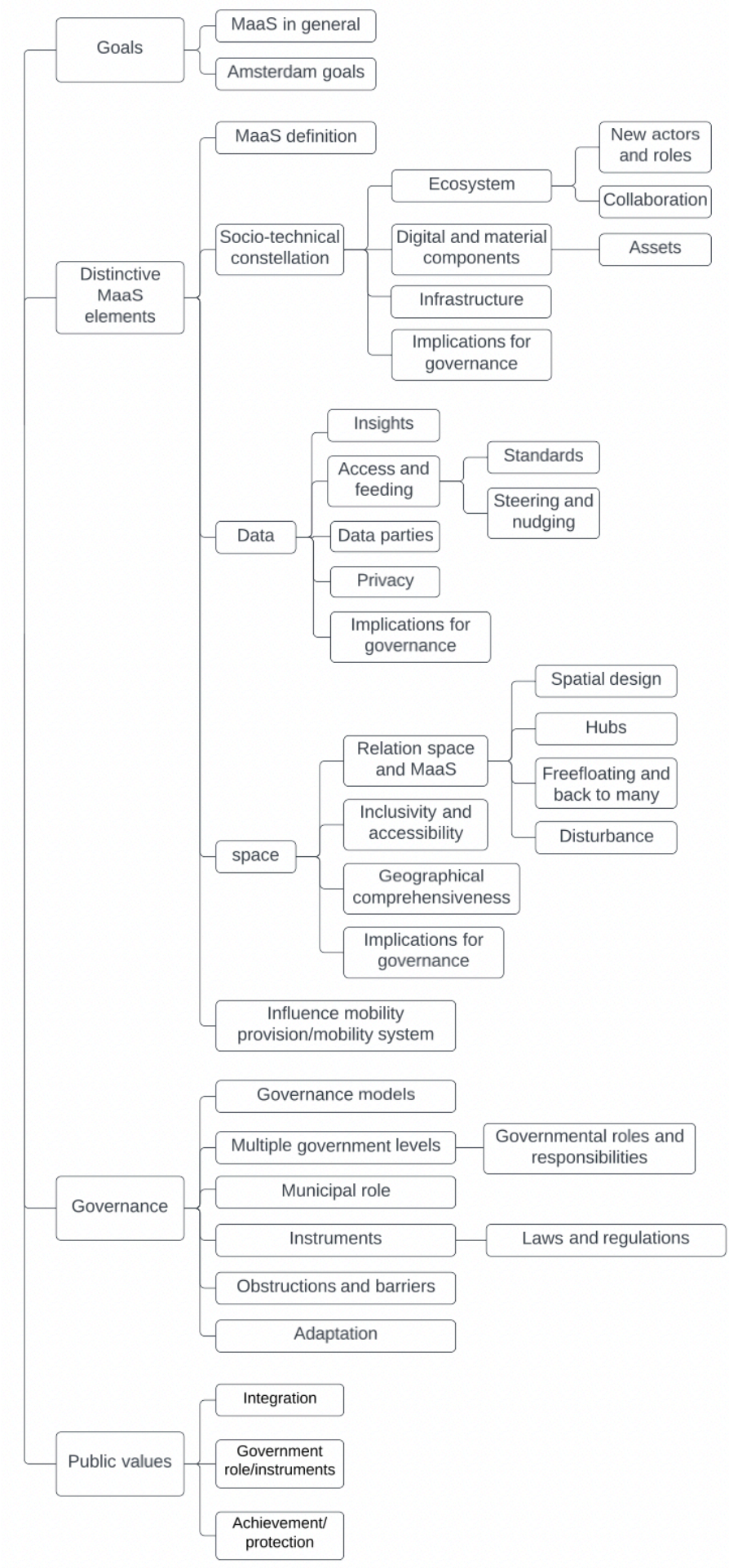


Figure 2.2: Overview MaaS ecosystem. Source: *König et al., 2016*

Offerings

1. Routes, fares, timetables, real-time locations
2. Available parking lots
3. Availability of private vehicles
4. Location, availability and fares
5. Manages the flows of goods and materials
6. Calculated individual (real-time) routes (are being adjusted on demand)
7. Ticketing, confirmation of booking, routing (based on perosnal preferences), guidance
8. Request for information (before booking and payment)
9. Booking and payment to MaaS operator
10. Booking of and payment for transport (minus MaaS operator commision)
11. Payment to the local public transport organiser
12. Key enabling HW and SW: mobile payment, routing, ticketing etc.

B. Code tree


Goals
MaaS in general
Amsterdam goals
Distinctive MaaS elements
MaaS definition
Socio-technical constellation
Ecosystem
New actors and roles
Collaboration
Digital and material components
Assets
Infrastructure
Implications for governance
Data
Insights
Access and feeding
Standards
Steering and nudging
Data parties
Privacy
Implications for governance
space
Relation space and MaaS
Spatial design
Hubs
Freefloating and back to many
Disturbance
Inclusivity and accessibility
Geographical comprehensiveness
Implications for governance
Influence mobility provision/mobility system
Governance
Governance models
Multiple government levels
Governmental roles and responsibilities
Municipal role
Instruments
Laws and regulations
Obstructions and barriers
Adaptation
Public values
Integration
Government role/instruments
Achievement/ protection

C. Interview guide

INTERVIEW GUIDE

General information
Date:
Begin time:
End time:
Name respondent (or pseudonym):

Introduction
Introduce myself with a short background note
Explain research relevance
Discuss duration and recording of the interview & confirm informed consent
Ask for expectations and or questions from respondent

Research question & sub questions

What does MaaS mean for the governance of Amsterdam's mobility system?

1) Why is MaaS of interest to the city of Amsterdam and what are the municipal goals for MaaS in Amsterdam?
2) What is distinctive about MaaS processes and what they mean for provision of mobility?
    a) What is the socio-technical constellation of Amsterdam's MaaS?
    b) What is the role of data in creating value for Amsterdam's MaaS?
    c) How is the Amsterdam MaaS platform co-constituted with urban space?
3) Given these characteristics, how could municipalities govern MaaS to ensure public value & equitable access to mobility*?*

Background interviewee(s)
- What is your current role & how are you involved with MaaS?

Interview questions
Ambitions and goals
- How would you define MaaS?
- What are for **you** (or your organization) the goals/what is your vision of MaaS (for Amsterdam or the Netherlands, depending on participant)?
- How does MaaS represent a new or different form of mobility provision to existing arrangements?

Socio-technical constellation
- What new opportunities are provided by digital platforms for mobility provision in the city?
    - How is the (public-private) collaboration designed?
        - How important is collaboration with actors considered?
        - What interest is there with which actors?
- How are new (private) digital/platform-based companies and organisations changing mobility provision & partnerships?
    - RiVier, Platforms (Amaze), MaaS integrators and operators
        - How can digitalization in mobility enable governments to steer on policy goals?

Data
- What is the role of data in governing mobility in the city & what needs to be considered to optimise data ownership/security/use?
    - How does the increased role of data and the insights this brings, change the way mobility is provided?
        - From perspective of transport operators, governments and users.

- How should the government/municipality position itself in the data infrastructure so that it can access and provide data for monitoring, steering, nudging, taking into account privacy and the (economic) business model of private actors?

Spatial arrangements

- In what way does MaaS influence the (development and shaping of) public physical space?
- In what way does the physical space impact the development of MaaS?
- How can MaaS be planned and implemented to ensure an accessible and inclusive mobility system?
    - How can MaaS create a geographically comprehensive service, also beyond the commercially attractive areas?

Public/societal values

- Should the development of MaaS focus on the integration of societal goals (MaaS integration level 4), and what should be done to reach this?
- To what extent is a governmental role necessary to achieve MaaS' goals and societal values (like accessibility, inclusivity, sustainability)?
    - Can this be accomplished without interference of the government?
    - To what extent are municipal instruments needed (richtlijnen, vergunningen, wetgeving)?

Governance

- What governance model would be appropriate for governing MaaS?
    - Private, public or mixture?
- What is the role of the municipality vs. the market in governing the delivery of MaaS?
- What do you think are the key threats/barriers to the 'successful' implementation of MaaS? (i.e. affordable, inclusive, efficient, sustainable etc).
    - And what does this mean for the governance of MaaS?
- What specifically would you change about the governance to ensure the successful implementation of Maas? (e.g. regulation, incentives, responsibilities etc.)
    - How does this change the role of the municipality in governing mobility systems?
- To what extent are governmental interventions seen as promoting or hindering for the development of MaaS? (Municipal instruments, 'MaaS waardige eisen', guidelines)
    - How far should governments go regarding obligations and requirements?

Finalisation

- How may I refer to you in the research: by name, function, anonymously?
- Do you have any questions, comments, or remarks regarding the interview?

Feel free to email/call me if any other questions come up or when you want to discuss something about this interview or the research in general.
Thanking the interviewee once again for its participation

End of interview

D. Informed consent form

INFORMED CONSENT

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Master Thesis Spatial Planning - Utrecht University

The effect of MaaS on the governance of mobility systems

My name is Maud Poels and I am a Master's student in Spatial Planning at Utrecht University, The Netherlands. I am currently finalizing my studies by writing my thesis. My research concerns the effect MaaS will have on the governance of mobility systems, specifically for the case of Amsterdam. To answer this rather complex question I will hold a series of interviews with different stakeholders related to this important subject for the development of urban mobility.

MaaS can offer a possible solution to numerous societal problems at hand. However, to start realizing and implementing MaaS, new governance structures and processes will be needed. Herein there are important organizational lessons to be learned about the legal conditions, relationship between involved actors and the governance culture, data, and urban and digital infrastructures. The purpose of my research is to examine the effect of MaaS on the governance of mobility systems. Focusing on this new, innovative, and complex concept in the context of Amsterdam, the research asks questions about:

- the reasons why MaaS is being developed and implemented in cities and the related municipal ambitions;
- the new aspects MaaS introduces with its development and the influence of these aspects on mobility provision;
- how these new aspects affect the way municipalities can govern MaaS and the mobility systems.

To investigate these research questions, I am collecting and analysing qualitative data comprising; a document analysis, a series of workshops around MaaS, and stakeholder interviews.

Our discussion will last between 45 and 60 minutes. An interview consent form should be read and agreed upon by email prior to the interview. It is hoped that this research will create more understanding of in what ways MaaS can affect the governance in mobility systems, in certain contextual specific scenarios, being Amsterdam in this case. I'd be happy to share copies of the reports and publications produced from this work with you.

Many thanks for your time and contributions!

Kind regards,
Maud Poels

INFORMED CONSENT FORM

Utrecht University

Master Thesis Spatial Planning - Utrecht University

The effect of MaaS on governance of mobility systems

INTERVIEW CONSENT FORM

Interview date:
Interviewee(s):

	Please tick to confirm
I confirm that I have read the information sheet and that I understand the purposes of the research.	
I agree to the online discussion being recorded and for notes made from the recording being used in research conducted by Maud Poels (for her Master's dissertation; thesis supervisor Dr. Rachel Macrorie).	
I understand that my participation in this (online) interview is voluntary and that I am free to withdraw, without giving any reason. If I decide to withdraw then I understand that the information I provide will not be used in UU research if my withdrawal occurs within 30 days of the interview.	
I understand that any information that I provide will be treated confidentially and will only be included in research presentations & publications in a completely anonymised form unless I agree otherwise.	
I understand that all data will be stored confidentially in password protected folders made available through the University of Utrecht computer network.	

_____

Participant's signature *Date*

_____

Researcher's signature *Date*

E. Interview transcripts

The interview transcripts have been included in a separate document due to their extensive length.