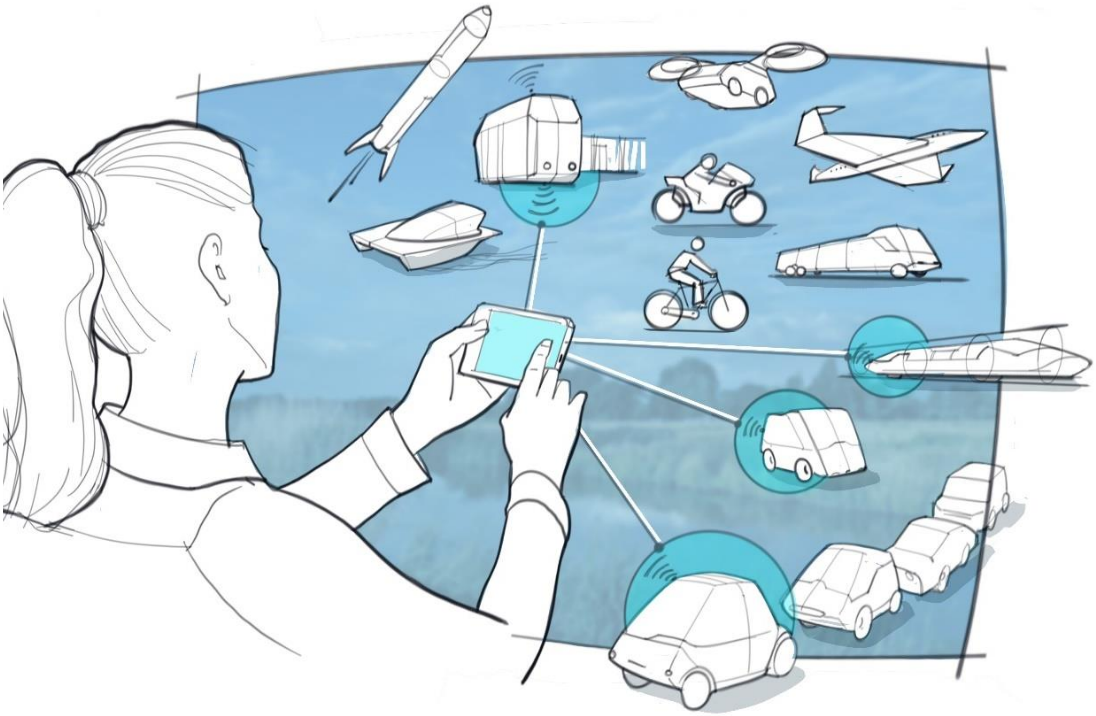
Master's Thesis – Master Sustainable Business and Innovation

The Dutch Mobility Transition: An Assessment of Governance Factors Contributing to Successful Implementation of MaaS in The Netherlands

"A qualitative research analyzing governance factors regarding the seven MaaS pilots, gaining insights for national implementation"



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Abstract

Mobility as a Service (MaaS): for the traveler, a mobility solution that efficiently combines different modalities on a platform that handles planning, booking, billing, and paying whilst considering personal preferences of the traveler. The concept of MaaS however, entails much more than a nice-looking app on a smartphone. It is a complex system consisting out of a myriad of interactions between many different stakeholders. MaaS can constitute a solution to many challenges such as congestion, enhancing sustainable mobility, lack of space in cities, clean air, and access to mobility solutions. It can be an alternative to a private car offering similar value. This research focuses on the concept of MaaS and implementation thereof in the Netherlands by analyzing seven MaaS pilots initiated by the Dutch Ministry of Infrastructure and Water Management (I&W). This study argues that the best governance model for MaaS is that of a (transaction) business ecosystem. As the focus is on the Dutch context, and many of the important areas of the MaaS ecosystem are the responsibility of public governance, the Dutch government (local, regional, or national) is rightly positioned to create the conditions for MaaS to thrive. To gain insight into which factors of governance contribute to the pilots' success, with the objective to scale the pilots to the national level, the following research question is posed: *"How do governance factors determine the success of the MaaS pilots' implementation in the Dutch mobility system?"* To give meaningful insight regarding this research question, qualitative research is conducted. Semi-structured interviews were held with 81% of the identified pilot stakeholders. The interviews were transcribed and structurally analyzed by performing in vivo coding. Corona delayed the start-up of the pilots and changed mobility behavior of travelers tremendously. The ecosystem paradigm emphasizes the importance of aligning and synchronizing the objectives of stakeholders participating in the pilots. The balancing of innovation and development of the ecosystem with standard-setting and applying rules is crucial for the MaaS ecosystem. It requires governance applied in a way considering these developments. Traditional approaches such as blueprints and linear development are no longer applicable in such a dynamic environment. This study recommends the appointment of an ecosystem manager which will mitigate many of the barriers identified and will increase the probability for the MaaS ecosystem to thrive.

Keywords: *Mobility as a Service, MaaS pilots, Governance, Transaction Ecosystem, Business Ecosystem, MaaS Implementation*

Contents

1. Introduction

A world without mobility is unthinkable. Today more than 7,5 billion people live on this planet (UN, 2019). All these people require forms of mobility to get them from point a to point b. The amount of people that require mobility is expected to rise with the increasing population as well as an increased usage intensity because of better socio-economic circumstances (Sustainable Mobility for All, 2017). Utilizing forms of mobility like conventional cars (combustion engine) currently comes with significant external costs such as greenhouse gas (GHG) emissions. These emissions are contributing to anthropogenic climate change. Currently, transport is the largest contributor to air pollution in cities and is responsible for almost 25% of GHG emissions in Europe (European Commission, 2016). As a result of the increasing intensity and amount of people using mobility, there is also more pressure on the current infrastructure causing congestion and other costly inefficiencies. Change is required to have a more sustainable and efficient system to meet the increasing mobility demand. This paper will focus on the concept of 'Mobility as a Service' (MaaS) as a potential solution.

MaaS can be described as an integrative concept which bundles different transport modalities into a seamless service offering, that provides a tailor-made mobility solution fulfilling traveler's needs (Smith et al., 2018, p36). This means that different modalities (e.g., car, bike, train) are combined on a single digital platform and are available for travelers to make an efficient and hassle-free trip. When MaaS provides a suitable alternative for traveling by (private) car, more people will be inclined to use this as an alternative, relieving pressure on existing infrastructure, decreasing GHG emissions, supporting social inclusion, and improving the efficiency of travel. The proposition for wide adoption of MaaS supports the sustainability goals of the Dutch government.

To realize the MaaS' tailor-made value proposition for the traveler, many different actors (stakeholders) will have to work together: transport operators, data providers, the MaaS platform providers, customers and users, regulators and policy makers, companies providing payment and ticketing solutions, journey planners, etc. The MaaS environment can be considered as a business ecosystem as this entails *"a dynamic group of largely independent economic players that create products or services that together constitute a coherent solution*" (Pidun et al., 2019, p2). A business ecosystem can be a solution to a business problem; a way to organize to realize a specific value proposition. Products or services could also be created by business governance models like a vertically integrated organization, an open-market model, or a hierarchical supply chain.

Kamargianni and Matyas (2017) also describe MaaS as a business ecosystem in their study as represented in Figure 1 below.

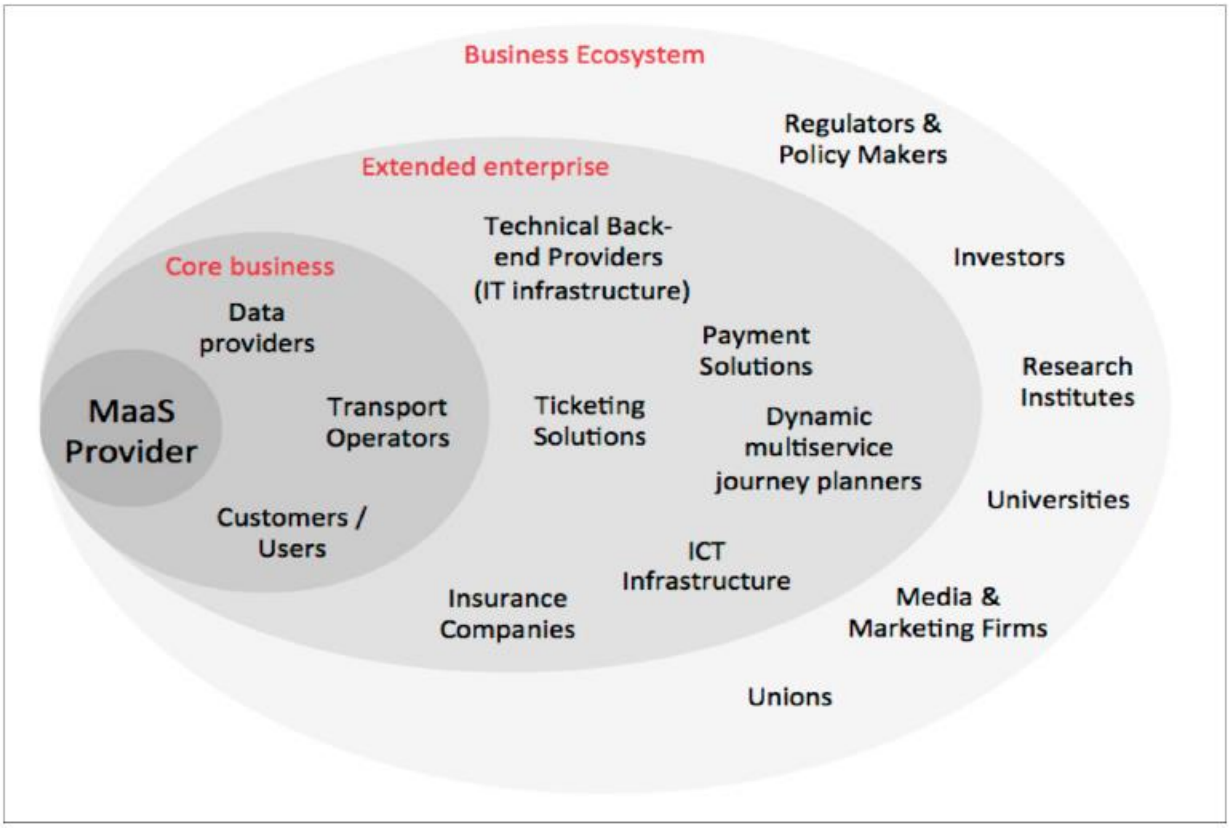

Figure 1. *MaaS as a Service business ecosystem. (Kamargianni and Matyas, 2017)*

The successful implementation of MaaS is highly dependent on the ecosystem within which it is being implemented. Several key conditions for the ecosystem to thrive can only be created by the government as they have the prerogative on legislation, spatial planning, road safety, creating a level playing field for competition, privacy, and so on. No other stakeholder(s) can fulfill this role, as is also observed by Vonk Noordegraaf et al. (2020) in their study on policy options to steer MaaS.

When looking at other countries, you can see that the extent to which MaaS can be successful is very case-dependent. The countries' ecosystems may differ vastly from each other (e.g., different actors, infrastructure, government, population density, travel distances). It is clear, however, that governance will play a key role in the creation of the right conditions within the ecosystem that could allow MaaS to thrive.

Acknowledging that **governance** is a broad term and is used differently throughout literature, it can be defined as *"a government's ability to make and enforce rules, and to deliver services"* and as *"the art of steering societies and organizations"* (Bressers & Kuk, 2003; Fukuyama, 2018, p3; Plumptre and Graham, 1999, p3). In this context, it would mean the ability to create the right circumstances for MaaS, for example through legislation and regulation by institutional change and by a coordinated approach involving societal stakeholders. In the case of MaaS in the Netherlands, the Dutch government is positioned to do just that.

For the government to make the right decisions resulting in better outcomes for society, it is important to be well informed on the complex dynamics of MaaS. Currently, very limited empirical studies about MaaS or its governance are available, resulting in a gap in the literature (Hirschhorn et al., 2019). This is confirmed by the Netherlands Institute for Transport Policy Analysis (KiM), as in their research agenda the need for research about the adoption of MaaS and decisions within MaaS are identified (Durand et al., 2018). For the Dutch government to gain experience and insight in their governing role of the mobility transition and in particular the Dutch MaaS ecosystem, the Dutch Ministry of Infrastructure & Water Management (I&W) has developed and started seven pilot projects in The Netherlands. These seven pilots will generate empirical data and focus on different aspects of MaaS in the Netherlands concerning the implementation of MaaS (I&W, 2019). By researching the seven MaaS pilots that are currently being conducted in the specific Dutch context, this research provides insights into key governance factors and their influence on the success of the implementation process of MaaS both within the pilot contexts and with regards to the scaling-up process to the (inter)national level. As argued before, the involvement of government (and its governance) is required to create the right circumstances for MaaS to become successful. Therefore, this research poses the following research question:

"How do governance factors determine the success of the MaaS pilots' implementation in the Dutch mobility system?"

These governance factors are important because they can encourage developments in the mobility transition to be more inclusive and steer them towards desirable outcomes for society by, for example, creating pricing structures, setting goals, regulating, and subsidizing (Pangbourne et al., 2018). This research will focus on key governance factors: Policy, Resources, Standard setting, Data sharing, and Coordination. These factors are expected to play a role in how a MaaS ecosystem can be formed successfully.

Even though more and more studies concerning MaaS use the term "Ecosystem", this term is hardly ever explained nor clearly defined. Based on Pidun et al. (2019), this research defines and describes why the **transactional business ecosystem** is an effective governance model to create a service like MaaS, compared to other governance models such as the supply chain or an open market model. This research also explains why the traditional approach of using the governance tools is lagging on developments in society and is mostly reactive instead of proactive. For example, the rapid development of Airbnb in Amsterdam led to nuisance for the local inhabitants. Existing regulations were not enough to manage this development. Only after massive protests of the local population, city government reacted by adapting city regulations and restricting renting out your house to a set number of days per year. The development of services like MaaS goes hand in hand with technological innovation and the creation of new (combinations of) services, requiring a more proactive and collaborative approach for applying the governance tools in practice. Lastly, this study also determines how and to what extent governance factors determine the success of MaaS. The insights acquired will help to increase the probability of success to implement MaaS and realize desirable societal outcomes with respect to for example sustainability, accessibility, social inclusion, and level playing field.

MaaS will be successful when many providers of transport (the wheels) and service providers participate to offer a wide range of solutions that fits the demands of many individual 'consumers' or 'travelers' in an easy way. The present supply of transport services (the wheels) is very scattered/fragmented with many different types of players (public transport companies, private transport companies, start-ups, companies with a long history, small, big, etc.) To create an integrated offering for travelers the complete supply side must be available for the optimal travel arrangement fitting the needs of each individual traveler. To create a fertile ecosystem for MaaS, the government is in a critical position to create key conditions for success. Creating the right ecosystem conditions for MaaS by lining up the supply side (mobility providers and service providers) and the demand side (travelers or organizations with travelers) on the right platform is an important first step for the government to create, promote, enhance, and organize MaaS in the Netherlands by using the right governance tools.

2. Theory

2.1 *The Concept of MaaS*

Over the past decades, there have been significant technological developments in both the technology and mobility sectors. As a result, online (inter)connectivity and the use of platform technology has advanced to the extent that it enables other/new technologies and concepts. One of the innovative concepts that have been enabled and created by these developments is the concept of Mobility as a Service (MaaS). MaaS can be described as an integrative concept which bundles different transport modalities into a seamless service offering, that provides a tailor-made mobility solution fulfilling traveler's needs (Smith et al., 2018, p36). MaaS is also described as *"an innovative mobility model that aims to bridge the gap between public and private transport operators on a city, intercity, and national level, and envisages the integration of the currently fragmented tools and services a traveler needs to conduct a trip"* (Kamargianni & Matyas, 2017, p.2).

This fairly new concept of MaaS was coined in Finland by Hietanen (2014) and is expected to instigate and contribute to a transition in the mobility sector. More specifically MaaS can play an important role in the paradigm shift towards more sustainable mobility (Li & Voege, 2017, p.100). MaaS has the potential to contribute to sustainability by efficiently utilizing available transport modes, reducing congestion, and promoting the use of sustainable forms of transport. MaaS can furthermore be beneficial for urban planning as fewer cars are required by optimized management and it provides mobility solutions for those who cannot afford their own car contributing to social sustainability (Li & Voege, 2017). Since MaaS is gaining more traction, decision-making must be done correctly to ensure that MaaS can reach its fullest potential. Since the concept of MaaS spans over different social, economic, and geographical boundaries, an ecosystem with strong collaboration and trust is of vital importance (Kamargianni & Matyas, 2017). To be able to analyze and make correct decisions regarding this transition, it is firstly important to establish what Mobility as a Service entails as there is no agreement on the exact definition of MaaS (Sochor et al., 2018; Pangbourne et al., 2020). Since stakeholders in this research need to have a mutual understanding of what MaaS entails the Dutch Ministery of I&W has determined the following working definition:

"Mobility as a Service is the supply of multimodal, (demand-driven) mobility services, where tailor-made travel options through a digital platform (e.g., an app) with real-time information is offered to customers, including payment and processing transactions" (Nieuwenhuizen & Veldhoven, 2018).

2.2 *MaaS as a Business Ecosystem*

The MaaS model as described in the previous section is a paradigm shift in how mobility services are distributed. According to Kamargianni and Matyas (2017), the necessary change for MaaS requires a business ecosystem with multiple organizations collaborating, exceeding the traditional boundaries of companies, business sectors, and users to realize co-creation.

Pidun et al. (2019) wrote a paper justifying the use of the business ecosystem as a governance tool. They first identify 4 basic models to organize the creation of a product or service based on the need for coordination and the modularity of the product or service to be delivered. The need for coordination is defined as the required level of coordination between the parties and stakeholders involved to create the product or service. Modularity means that the components of the product or service are designed independently but function as an integrated whole. The 4 governance models that Pidun et al. (2019) explain are:

- The vertically integrated model: all key activities are performed within one organization.
- The hierarchical supply chain model: certain activities are outsourced to suppliers from which you buy and/or intermediaries to which you sell.
- The open market model: the customer selects and buys the required components from independent and uncoordinated providers in an open and competitive market.
- The business ecosystem model: a dynamic group of largely independent economic players that create products or services that together constitute a coherent solution; coordination with other, largely independent (economic) players to create a coherent product or service. A product or service solution that exhibits high modularity if its components can be combined easily and flexibly integrated at low (transaction) cost and close coordination among the components clearly benefit the customer.

Figure 2 shows these governance models.

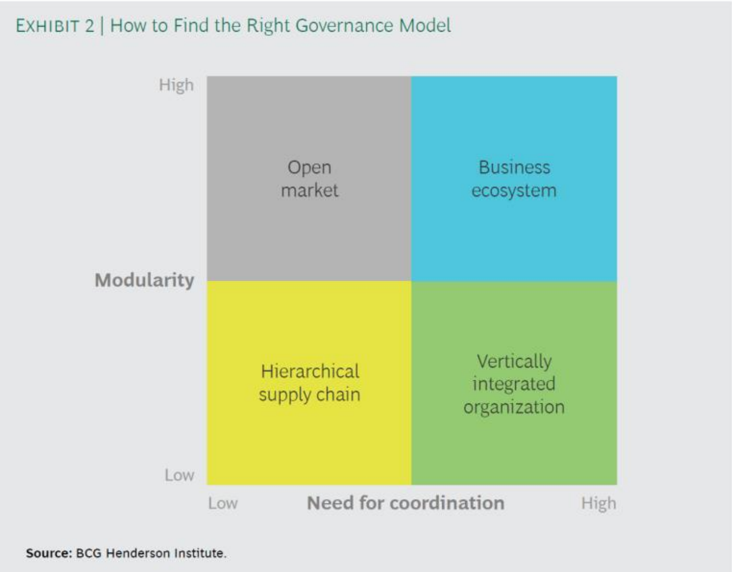

Figure 2. *Finding the right governance model (Pidun et al., 2019)*

Since MaaS entails the ability to use many different modalities integrated on a platform, the need for coordination between many (large) economic actors required to deliver the convenience of MaaS is (very) high. Also, the modularity of MaaS is high because it requires the various actors to provide and design their (real-time) service information to interact with the integrated whole (the platform). Since the need for coordination and the modularity of the MaaS concept is high it fits in with the governance model of a Business Ecosystem (figure 2).

The characteristics of the business ecosystem as a governance model explained by (Pidun et al., 2019) consist of:

- **Modularity**
- **Customization**: the contributions of the ecosystem participants tend to be customized to the ecosystem and are made mutually compatible
- **Multilateralism**: in ecosystems, a set of relationships cannot be decomposed to an aggregation of bilateral interactions
- **Coordination**

Also, when looking at the characteristics 'Customization' and 'Multilateralism' you find that this suits very well with MaaS. The goal of MaaS is namely to have tailor-made solutions for every customer. Furthermore, MaaS is highly dependent on multilateralism as it requires many parties to participate to create the added value of multi-modality.

Pidun et al. (2019) continue to explain that there are 2 basic types of business ecosystems which are shown in figure 3; Solution Ecosystems and Transaction Ecosystems: First, the **solution ecosystem** where a core firm orchestrates the offerings of several complementors and suppliers to create the solution. In this case, the customers are not active members of the ecosystem but select and combine the offering of the core firm and the complementors. Second, the **transaction ecosystem** is characterized by a central platform linking independent producers of products or services with independent customers. Transaction ecosystems are two-sided markets benefitting from direct and indirect network effects (Pidun et al., 2019). Direct effects occur when participants value the offering more as the number of other participants on their side grows. Indirect network effects are present when the value of the ecosystem for the participants on one side of the market increased with a growing number of participants on the other side.

The following figure shows the 2 forms of ecosystems.

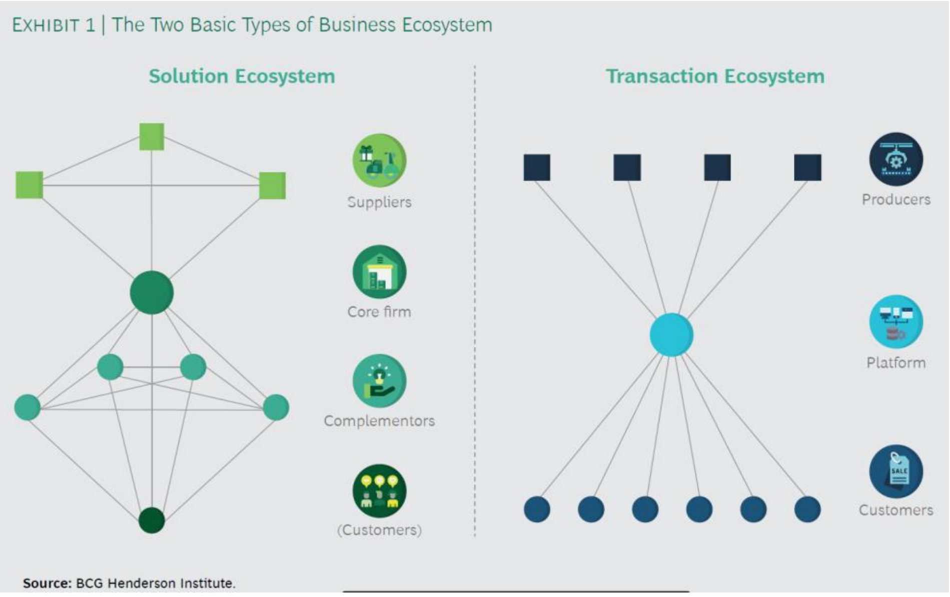

Figure 3. *The two basic Business ecosystem types (Pidun et al., 2019)*

The purpose of the transaction ecosystem is matchmaking where the value creation can be measured by the number of successful transactions and benefits to both sides of the market (Pidun et al., 2019). They further explain that the platform orchestrator manages access to the platform, established the standards and rules, and sets the incentives for both sides of the market to grow the ecosystem and exploit network effects. Reading the definition of MaaS by Smith et al. (2018), the characteristics of the Business Ecosystem match very well.

2.3 The role of government and governance

Mobility is regarded as an important value by the Dutch government that enhances economic growth as well as individual wellbeing. This is expressed by the vision of the current Minister of Infrastructure and Water Management Cora van Nieuwenhuizen:

*"Mobility does not only contribute to the economy but also our wellbeing. It is about being able to live, work and recreate comfortably. Good mobility is important so we can make a living and meet each other" (*Rijksoverheid, *2020)*

With the growing population and growth of the demand for individual mobility the risk of congestion of the system increases as well as the burden on the environment. Hence the desire of the Dutch government to support the growing demand for mobility and at the same time to minimize the negative effects of increased mobility.

Mobility as a Service (MaaS) provides a potential solution direction to meet increased mobility demand while reducing the negative environmental effects as well as the capacity issues.

Within the ecosystem of MaaS, there are many different participants. From the supply side: start-ups, companies existing over a century, small companies, big companies, hardware providers and service providers, infrastructure, payment services, etc. Next to that, meeting the demands of the individual customers is quite complex as their mobility requirements can vary by day.

Many elements that must be coordinated and governed cannot be handled by one single player in the business ecosystem. They involve legislative subjects like privacy, consumer rights, legislation on competition, but also infrastructural investments, environmental planning, etc. Within a democratic nation-state, the only stakeholder able to tackle all these issues is the government or one of her governmental bodies. Hence with regards to MaaS, the role of the Ministry of Infrastructure &Water Management is obvious.

Additionally, the present mobility industry make-up provides barriers to move from the existing situation to a fully implemented MaaS system. Existing legislation, rules, permits, etc. need to be reviewed and adapted to create an ecosystem that is suitable for the implementation of MaaS. The Finnish government for example has done so by having drafted the 'new transport code' (act. 1.7.2018) intending to dismantle regulation and promote new service models, and easing market entrance (Surraka et al., 2018). There is also legislation and rules that are not yet present, but which are required to bring structure and order in the complex world of MaaS with its many different and diverse stakeholders. Proper governance is a prerequisite for the successful development of an ecosystem that is healthy for MaaS. Not just on a national level but also on a supra national level like for example the European Union. Governance can steer the MaaS developments to desirable outcomes for society by for example designing targets, subsidizing or setting other pricing structures, and implementing policy regarding consumer protection (Pangbourne et al., 2018). As this is a multi-facetted transition that concerns many stakeholders on different societal levels, governance of and collaboration with all the stakeholders is very important. Certain rules of engagement and regulations are required for fair competition and collaboration with clear boundaries to take place. To analyze how governance plays an important role in the managing/promotion/enhancement of a transition to MaaS models, lessons can and should be drawn from the previous governing experience of MaaS projects as it is essential for the public sector to understand how institutional arrangements can influence MaaS development and diffusion (Muhktar-Landgren & Smith, 2019). Within governance, the public authorities can position themselves in different roles regarding the MaaS transition i.e., very strict with many regulations or, with deregulation and laissez-faire (Pangbourne et al., 2018). These different roles toward MaaS have varying impacts on the outcomes and processes in the transition towards MaaS.

Specific local circumstances (e.g., type of governance, population density, geographical circumstances, public transport) can have a specific impact on the implementation of MaaS solutions. For example, when contrasting Finland with Switzerland you see significant differences in terms of local regulation and legislation. For example, Finland as a republic has two administrations namely national and municipal where legislation is the same for the whole country (Surakka et al., 2018). Switzerland is a confederation where cantons, districts, and municipalities have relatively more power (Surakka et al., 2018). Hence local legislation within areas of Switzerland could prohibit or hinder the development of inter-regional connections and collaboration required for the successful implementation of MaaS. On the other hand, Switzerland is not part of the EU so does not have to consider legislation from Brussels. These governance characteristics should be considered when actively engaging in the implementation process. When comparing these cases to the Netherlands, you find that the governance on national and regional levels is comparable to that of Finland. In literature, however, research regarding the governance of MaaS pertaining to The Netherlands is still limited (Durand et al., 2018). This can partly be attributed to research that is not disclosed for commercial purposes according to the Dutch Ministry of Infrastructure and Water Management (Durand et al., 2018). Also, Hirschhorn et al. (2019) identify a 'Void' in current literature regarding MaaS and its governance, there are 'few empirical studies'. Because of the limited research focused on MaaS in the Dutch mobility transition context, more empirical research is needed. This research will help to gain insight into how the complex MaaS ecosystem can be conceptualized and approached, aiding in the decision-making processes for policy and other measures of government intervention. Even though we can learn from examples such as Finland with many similarities, you must consider that there are still many differences such as population density and geographical size. Therefore, this research focuses on the specific Dutch conditions, circumstances, and developments concerning the implementation of MaaS in The Netherlands, by analyzing 3 of the seven MaaS pilots set up by the Ministry of I&W with the purpose of *"building learning experiences with MaaS applied on a big scale by MaaS providers, transport providers and government bodies"* (I&W, 2019).

2.4 *The Conceptual Model*

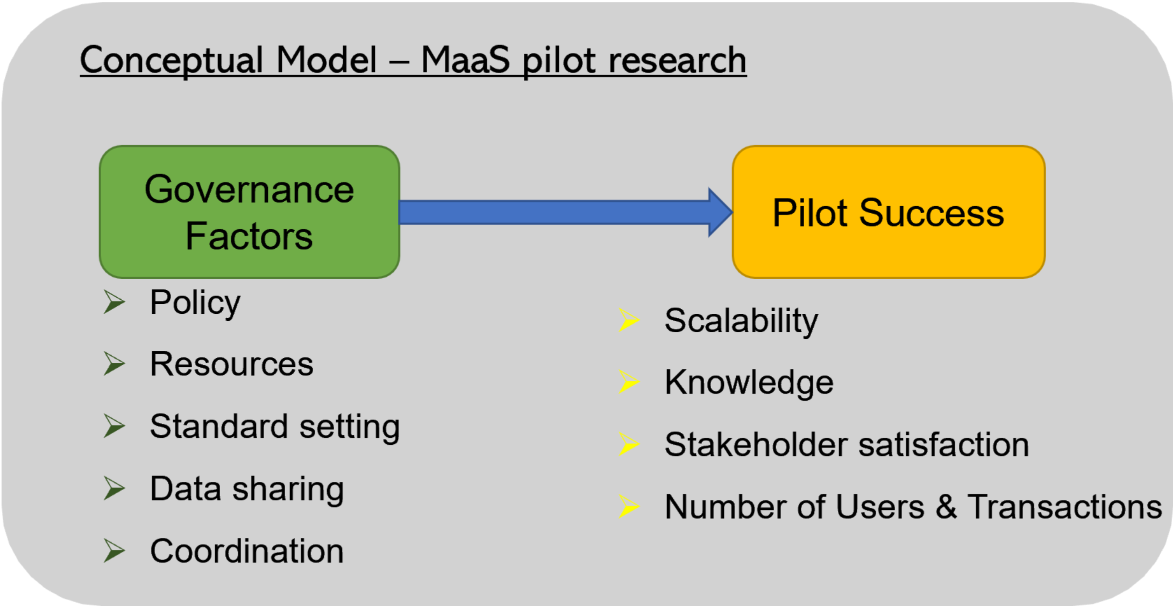

Figure 4. *Conceptual model of the MaaS pilot research*

The conceptual model as depicted in figure 4 aims to give a clear presentation of the variables that are being researched: Governance factors in relation to the success of the reviewed pilots. In this representation, the governance factors are on the left in green and the factors that influence pilot success are on the right in yellow. The governance factors in this conceptual model are the independent variables and the factors constituting success are the dependent variables.

Policy is used as an independent variable as this is a factor that influences the dependent variable, policy is a factor that only the governing body can exercise and includes regulation and administration (Koschatzky, 2005). The second independent variable is 'Resources'. Resources refer to the funding and facilitating the start-up of the MaaS Ecosystem, access to infrastructure, and other material/immaterial goods that can be utilized for the success of the pilot. Especially the allocation or management of resources can be used as a governance tool. Thirdly, standard-setting assures that all providers adhere to the same technical standards so data and information can be shared effectively and efficiently among the stakeholders within the ecosystem. Standards for assuring privacy and data security are part of this variable.

The fourth governance factor is data sharing. Data sharing is an important factor that can be an enabling factor in the interoperability of different stakeholders within the MaaS ecosystem. For this highly complex system to work efficiently, availability and access to data are required to optimize integration and capacity. All data should be available to create the optimal travel arrangement.

Factors that are used to determine pilot success in this research are: Scalability, Knowledge, stakeholder satisfaction, and the number of users & transactions. The objective of I&W is to apply the learnings of these pilots on a national scale to integrate MaaS as part of the Dutch mobility system. The scalability of the pilots is, therefore, an important indicator of success.

Knowledge is also one of the main aims identified by I&W. Each pilot study aims to build up knowledge and experience, this knowledge and experience will function as a starting point for creating the MaaS ecosystem on a much bigger scale. Furthermore, stakeholder satisfaction as a measure of success is listed. This is an important variable in this research as the level of satisfaction especially when addressed in a qualitative matter can provide insight as to what aspects of governance within the pilot are perceived as good or bad and is about the extent to which the goals of the stakeholders are met. User satisfaction is important as the MaaS concept is user-centric (Giesecke, 2016). Lastly, the number of users and transactions is also identified as a measure of success because in the transaction ecosystem value is created by the number of transactions (Pidun et al., 2019). The number of users and transactions is directly linked to the business model of stakeholders like MSP's and TO's. More generic, the intention of creating the MaaS ecosystem is that is being used as much as possible. For transport operators and platform providers it is important as the business case is an important element of their stakeholder satisfaction.

3. Methodology

3.1 Research Design

This research utilized the design of a comparative case study. A comparative case study design entails a comparison between different cases that share a common focus or goal allowing analysis and synthesis of differences, similarities, and patterns, producing knowledge that allows for generalization of causal questions (Goodrick & Delwyn, 2014). Goodrick and Delwyn (2014) furthermore mention that a comparative case study design is an appropriate impact evaluation design for explaining the influence of context for the success of program and policy initiatives. For this research, this design was chosen as different pilots are compared and contrasted with the focus of comparison being the afore-described governance factors and how they affect the success of the pilot.

3.2 Data Collection

The data required for making the comparisons was acquired by performing semi-structured interviews. The decision for semi-structured interviews was made to bring a form of structure to the necessary topics while allowing for flexibility in terms of the interviewee's expression and line of questioning for the flow of conversation (Drever, 1995). Semi-structured interviews furthermore allow asking deeper questions to the response of interviewees gaining better insight into the interviewee's perspectives (Drever, 1995). The semi-structured interviews were based on an interview guide and questions (Appendix A, B) which includes questions about topics such as the context of the particular MaaS pilot and questions regarding governance and how this is perceived. The interviews were conducted in Dutch and possible quotes were translated by the researcher. The sampling strategy that is utilized is a form of purposive sampling namely chain-referral sampling, this entails that the interviewed stakeholders recommended other important stakeholders that aligned with the research scope (Mack et al., 2005). The total sample size of this research consists of 17 interviewees which are part of one of the seven pilots or who are part of the Ministry of Infrastructure and Water Management. In accordance with the actors that participated in the research, interviews were recorded, allowing their responses to be analyzed for the research.

3.3 Data Analysis

The recordings can be considered as the raw data and were transcribed after which the text was analyzed. The analysis of the transcript was performed by 'in vivo coding', in qualitative research this entails the process which enables the data (the transcribed interviews) to be assembled, categorized, and thematically sorted to provide an organized platform for the construction of meaning (Williams & Moser, 2019). Charmaz (2006) describes coding as a pivotal link between collecting data and developing an emergent theory to explain the data. The analysis by coding was furthermore chosen as it also allows to find causal relationships from the interviewee's responses (Maxwell, 2004). To perform the coding of the transcribed data, a software program called 'NVIVO' was utilized. NVIVO is a widely recognized software program that allows for the structured analysis of qualitative data. The analysis process of the transcribed data consisted out of three 'coding' stages: open-coding, axial-coding, and selective-coding.

Open coding as the first step of the analysis entails the process of assigning a code/label to represent the core of what is shown in the data (Baralt, 2012). According to Corbin and Strauss (2008), it can be seen as breaking the (raw) data apart to delineate meaning that refers to core characteristics (Corbin and Strauss, 2008). To illustrate how a code can be derived from raw (interview) data, here an example:

"The municipality of …. aims to have better air quality in their center and therefore restricts cars that pollute above a certain level"

A core characteristic that is identified in this raw data is 'local policy' and therefore can be labeled/coded as such. It is also possible to attribute more codes to the same raw data, within this example that could be the code 'air pollution'.

The second step of the coding process was axial-coding. During this step, the created codes/labels were synthesized and more coherently organized in hierarchically structured categories and subcategories, adding nuance and dimension to emerging concepts (Scott & Medaugh, 2017). By doing so, axial coding adds depth and structure to the existing open codes (Gorra & Kornilaki, 2010). In short, the categories can be considered as a cluster of codes that share similar core values. Figure 5 below illustrates this by attributing different codes such as local policy to the broader category of Policy.

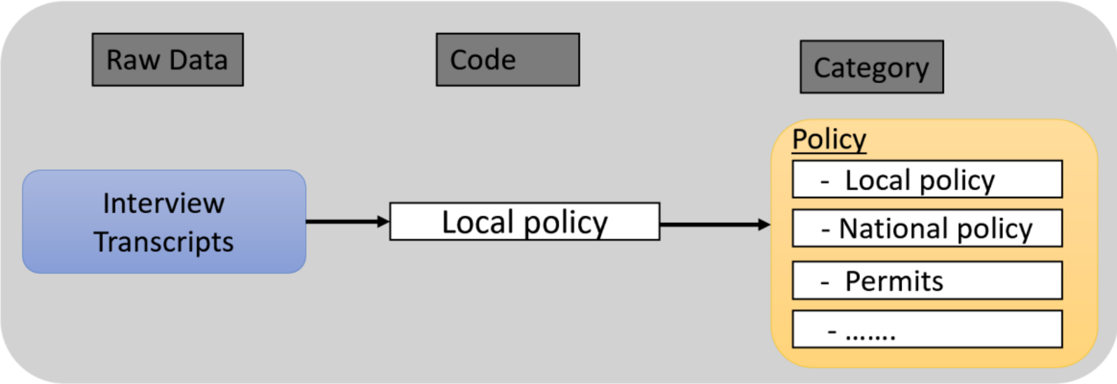

Figure 5. Schematical overview of open-coding and axial coding

The third and last coding step is 'selective coding', here a 'core' concept is identified by which most if not all of the other categories are unified (Chandrasegaran et al., 2017; Holton, 2007). Selective coding provides richer dimensions of the research problem (Urquhart, 2012). In figure 6 below the selective coding is illustrated with the following example: Policy as a category (consisting out of several codes) relates to the more general concept of Governance since it is a tool utilized in governing. On the other hand, you see the category of Resources, this category is also linked to the concept of Governance as the allocation of resources can be used as a governing tool.

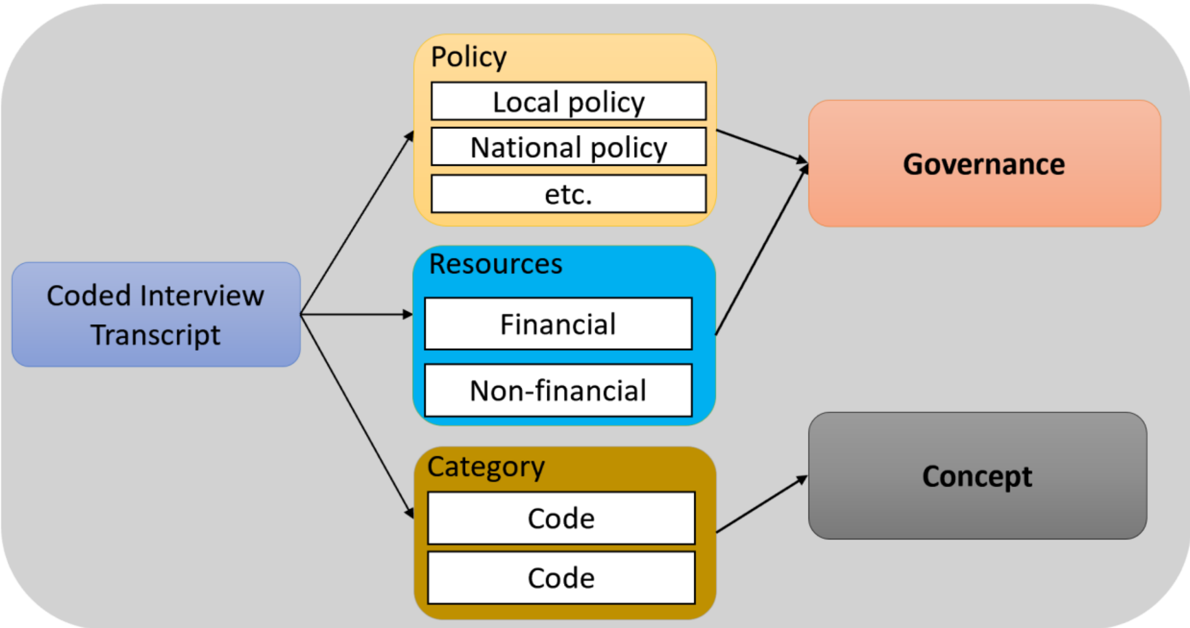

Figure 6. Schematical view of the coding process: open coding,axial coding and selective coding

Since the concepts consisting out of the different layers of categories with their respective codes and raw data, the coding process has provided a very clear and densified overview of a plethora of information. A clear overview of this information aids to draw meaningful conclusions based on this information. The final step of the analysis utilizes this by synthesizing the concepts to better understand the influence on and relationship with the research question. This last step in the analysis allows for the creation of insights into how the research question can be answered and how possible theory can be generated (Baralt, 2012). The findings from the analysis are related to the theoretical/conceptual framework and to the different emerged concepts in particular to gain insight into how governance factors affect the success of the pilots. The whole analysis process is visualized in figure 7 below.

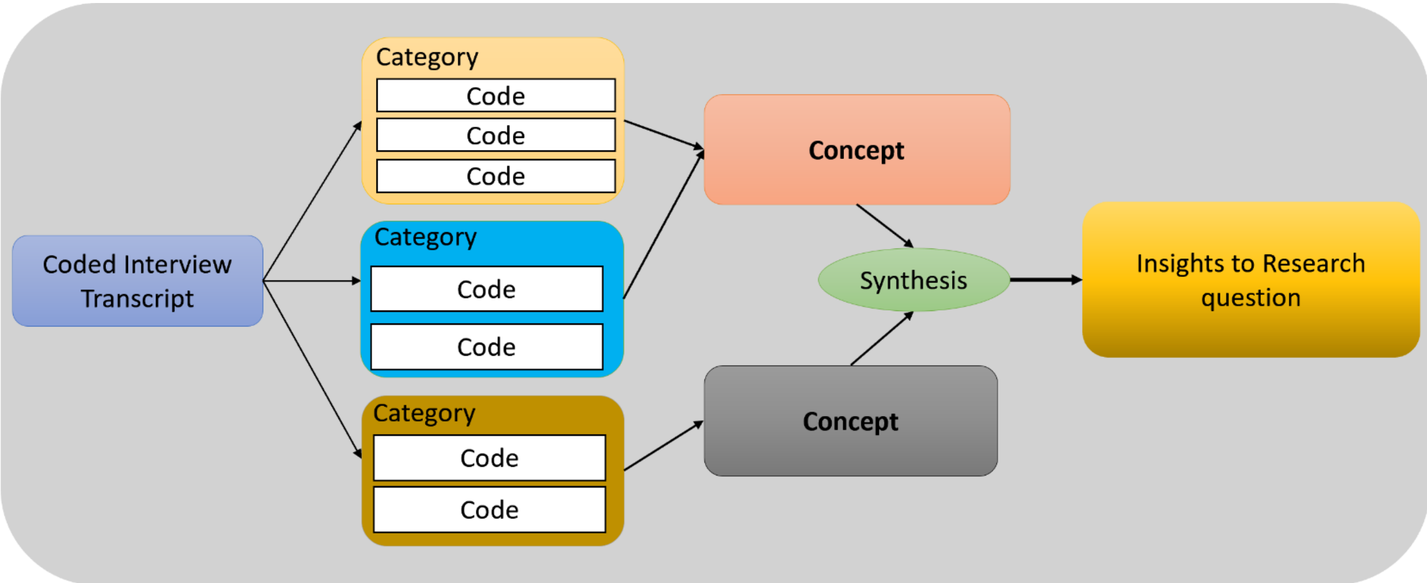

Figure 7. Schematical overview of the whole coding and analysis process

Based on the outcomes of the analysis conclusions will be drawn regarding what aspects of governance are of importance to the success of the pilots.

4. Research context and pilot scope

For the proper interpretation of the results, it is important to be aware of the context of each pilot, therefore a short description of the context and focus of each of the pilots is provided below. By knowing the context and focus of the pilots it becomes easier to understand why there may be contrasting arguments made for the same concepts.

4.1 Pilot context

Pilots to gain insight: The seven MaaS pilots

Because few empirical studies have been performed regarding MaaS, especially in the Dutch context, the Dutch government instigated seven pilots which can be empirically studied (Hirschhorn et al., 2019). Morin (2013) defines a pilot as the conduct of the main study but on a small scale. Pilot studies are conducted to identify practical problems (Van Teijlingen & Hundle, 2001) and to appropriate risk mitigation strategies (Turner, 2005). Turner (2005) furthermore identifies that a pilot study can be used to gather data on technical and commercial feasibility. In the case of the MaaS pilot, these are some of the reasons why the Ministry of I&W is currently conducting seven different MaaS projects in The Netherlands. Their goal is to gain insights and experience concerning the implementation of MaaS (I&W, 2020). The seven projects focus on different aspects of MaaS but what they have in common is that they are conducted within the Dutch context. Most of the pilots have started in 2019 and initially planned to finish in 2021. Since only limited research is available about Dutch governance strategies regarding MaaS and insights from other aspects of MaaS, it is worthwhile investigating what the important/critical governance issues/subjects are in the different projects, how they relate to each other, and what this means for the further development of MaaS in The Netherlands. Further detailed information regarding each individual pilot can be found below.

The seven pilots

Amsterdam Zuidas

The MaaS pilot of Amsterdam is mainly focused on the Zuidas area. This area is a well-known business district where many international businesses are located and where many business fairs take place. It is also where the World Trade Centre is situated. The goal of this pilot is to increase the accessibility to the Zuidas area with the main focus being on the urban professionals that travel in and around this area (Puylaert, 2020). The MaaS proposition in this area aims to offer a good alternative for travel with lease- and private cars, thereby decreasing the pressure on infrastructure and contributing to more sustainable travel. The tender for this Pilot has been awarded to the Consortium of Amber, Radiuz, Transdev and Over Morgen (Puylaert, 2020) They call the consortium ‘Amaze’, and this will also be the name of their platform.

Rotterdam The Hague Airport

The pilot of Rotterdam The Hague Airport has the focus to increase the multimodal accessibility of Rotterdam in general and The Hague Airport in particular for the increasing number of international travelers (Kerssies, 2019). By offering better multimodal transport opportunities, they aim to optimize the (public) transport capacity decreasing infrastructural pressure and reducing carbon emissions. Furthermore, it aims to create better social inclusion for travelers that have limited access to forms of transport. The tender for this pilot was awarded to a partnership led by PON, renowned importer of Volkswagen and owner of the Gazelle bike brand. The partnership constitutes of Pon, Tranzer REISinformatiegroep, CGI, Greenwheels and Shuttel under the name of MOVES (Kerssies, 2019).

Utrecht Leidsche Rijn and Vleuten-De Meern

The tender for Utrecht's MaaS pilot was awarded to Innovactory, which developed a platform called Gaiyo. The area on which they currently focus is Leidsche Rijn and Vleuten – De Meern. The tender specified this area as there will be a significant increase in new residents in this area and since car ownership is significantly higher than elsewhere in Utrecht (Puylaert, 2020). The focus will mainly be on the residents so not necessarily on business travel as opposed to some of the other pilots. Their goal is to increase accessibility to (shared) mobility and to reduce the amount of car ownership (Puylaert, 2020). The pilot of Utrecht is the first pilot to has officially been launched and is currently running.

Eindhoven

The MaaS pilot in Eindhoven is a partnership with 3 parties namely: ASML (a large high-tech company), the municipality of Eindhoven, and Brainport Development, they will work with ICT Group to develop the platform which is called TURNN (Kerssies, 2019). The main goal of this pilot is to increase the sustainability of business travel, as the municipality of Eindhoven wants business travel to have zero carbon Emissions in 2025 (Kerssies, 2019). It is expected that the platform will have a high adoption as ASML, and municipality employees will be encouraged to use to platform and other businesses as well.

Limburg

The tender for Limburg's MaaS pilot was awarded to Arriva, a big public transport company. The platform that they use is called Via-Go and is created in collaboration with Tranzer and TURNN (Rottier, 2019). The focus of the pilot in Limburg is mainly on cross-border mobility since currently seamless cross-border mobility with different modalities is almost nonexistent resulting in high car ownership within the region (Rottier, 2019). The platform however will also work for travel within the Netherlands. In short, their goal is to increase (international) accessibility and reduce the carbon footprint of travel.

Groningen & Drenthe

The pilot in Groningen & Drenthe has officially started on the 1st of December 2020 making it the last pilot to start. The pilot tender was awarded to Arriva, which is the also the MSP of Limburg. In this pilot, they will also utilize the Via-Go app as a platform for their MaaS proposition however it will be tailored to the focus of this pilot. As the area of Groningen and Drenthe has a far lower population density and can be considered as rural, the focus is different compared to the pilot in Limburg. The main focus of this pilot is therefore on private transport and travelers of the social domain (Jacobs, 2020).

Twente

The pilot of Twente focuses on the 8 municipalities of this region. Similar to the area of Groningen and Drenthe, population density is relatively low compared to the other pilots. The pilot tender was awarded to Qarin Tranzer, they are developing a platform called 'Goan' which means 'going' in the local dialect (Veelenturf, 2020). Within this pilot, the focus is relatively broad as it aims to provide the MaaS service to all of the municipalities with a focus on private transport of various target groups such as elderly and disabled people. The overall goal of this pilot and the platform is to make (public) transport more accessible, efficient, and cheaper (Veelenturf, 2020).

4.2 Interview scope

In total 17 interviews have been conducted with different stakeholders of the MaaS pilot. The main stakeholders on which the research focused are the project managers, the MaasServiceProvider (MSP), and the contract managers. These were selected as the main stakeholders as it is assumed that they can offer the best insights regarding the research question of governance and success. The project manager is considered an important stakeholder as he works for the local municipalities forming the bridge to local and national governance and contributes to implementing MaaS in their region. The MSP is also a very important stakeholder for this research because they provide the actual MaaS service and are important for this research since they are subject to the various forms of governance. The contract manager is also considered an important stakeholder as the contract manager's role is to initially form the legal framework and agreements by which the MSP's and municipality must abide. Furthermore, the contract manager works for the municipality and oversees whether the requirements for the tender are met by the MSP and aids the process where the direction is needed. Besides these stakeholders, interviews were conducted with members of the Dutch ministry of infrastructure concerned with MaaS and with the 'Leeromgeving' which stands for 'learning environment' which is also part of this ministry. These interviews were conducted to gain more insight into the overall process and to gain an understanding of which stakeholders were important to include. In figure 8 below it is depicted which of these stakeholders have been interviewed in the different pilots. In total 81% of the important pilot stakeholders have been interviewed allowing for a good saturation of the research.

Stakeholder	**Pilot**	Amsterdam	Utrecht	Eindhoven	Rotterdam	Limburg	Twente	Groningen
Project manager								
MSP								
Contract manager								

Figure 8. *Different interviewed stakeholders*

Interviewed
Not interviewed

5. Results & Analysis

The results and analysis are a process of aggregation, distillation, and synthesis to come to meaningful conclusions with regard to the research question. First, the aggerated results will be discussed. Secondly, the results and analysis of all the selected categories will be performed. Lastly, the results and analysis of the different concepts will be done relating them to the research question.

5.1 Aggregated results

The questions asked in the interviews have been constructed and formulated around the theoretical framework of this study, the research questions(s) and the assumptions made. The coding process as described in the methodology consists out of different coding steps; raw data to codes, codes to categories, and categories to concepts. The table below shows which categories were identified and the number of codes that attributed to them. It also shows in which concept the category fits. The categories are marked in blue and the table furthermore shows the number of interviews in which concepts are mentioned and the number of times the concept is mentioned. This table can therefore give an indication of the extent to which the concepts are central within the categories and to how prevalent they are in the general context of the interviews/transcripts.

General Findings	Number of Interviews	Number of times mentioned	Codes per category
MaaS Definition	11	12	1
Active user Definition	13	23	3
Competition	11	20	2
Platform and app	11	21	2
Corona	13	29	1
Goals	11	27	2
Drivers and Barriers	12	29	6
Ecosystem	13	68	5
Governance			
Policy	14	104	13
Resources	14	49	9
Standard Setting	14	65	4
Data sharing	14	125	4
Coordination and communication	14	108	14
Success			
Scalability	14	36	4
Knowledge	14	67	5
Stakeholder Satisfaction	14	26	2

Table 1. *Representation of categories per concept and their (coded) prevalence in the transcripts. The concepts are marked blue, the categories in yellow. In grey are categories*

that are considered as interesting but will not specifically be analyzed. These results are based on the coding which can be found in Appendix C&D.

5.2 Category results and analysis

In this section, the relevant results and analysis of the categories that were identified in the coding process will be elaborately explained. Thereafter in section 5.4 the categories in relationship to their concept will be discussed.

5.2.1 *Maas definition*

As described in the introduction the literature identifies that there is no agreement on an exact definition of MaaS (Sochor et al., 2018; Pangbourne et al., 2020). This also becomes clear when asking the interviewees how they would define MaaS. Since these interviewees work daily in the field of MaaS and could be considered experts, it is remarkable that they define the MaaS differently. When people work together to accomplish something, it is important to have a mutual understanding of the core value in this case to the concept of MaaS. For this reason, it is decided to include this as a category in the result and analysis section. To illustrate the differences here are two examples of how MaaS is defined:

The first quote

"The concept of MaaS is aimed to provide a traveler with access to mobility supply in the form of an application. This application provides different traveling possibilities and allows for planning, reserving, and booking with helpdesk functionality on a single platform"

The second quote:

"The concept of mobility is about different forms and combinations of propositions between various services, enabling travelers to move differently and more flexible. This can be beyond planning booking and payment, combining it with other forms of services towards the end-consumer …. it goes beyond just an application."

These quotes represent one of the main differences in how the different stakeholders define the concept of MaaS. In the first quote, you see that the concept is mainly focused on what the concept of MaaS merely is to the end-user. The second quote on the other hand illustrates that the concept of MaaS encompasses a lot more than merely the platform for an end consumer but that it goes beyond that. The interpretation of this research aligns more with the second definition as it becomes clear in this research that the concept of MaaS encompasses more than merely an application that serves the needs of customers. Most of the categories that are described below can give insights into the multi-faceted depth of the concept of MaaS.

5.2.2 Ecosystem

Although the word 'ecosystem' is not used very often by the interviewees, important elements of the definition of a business ecosystem like MaaS are mentioned frequently. In section. 2.2 it was concluded that the MaaS ecosystem is a **transaction ecosystem.** Below the different aspects of MaaS mentioned by the interviewees, will be related to the earlier mentioned definition of the business ecosystem as defined and discussed in the Theory section (section 2.2).

The business ecosystem model:

- a dynamic group of largely independent economic players:
    - *Different transport operators offer different solutions on an independent economic basis: bus, train, and metro companies, shared mobility providers (step, bike, e-bike, e-scooter), privately owned car, taxi, WMO-taxi.*
- that create products or services that together constitute a coherent solution.
    - *The door-to-door transport using different modalities with 1 app on your smartphone constitutes a coherent solution including planning, booking, billing, and paying for the trip.*
- coordination with other, largely independent (economic) players to create a coherent product or service.
    - *The MaaS service provider links the independent economic players together to create the coherent product of door-to-door transport based on the individual travelers' requirements.*
- A product or service solution that exhibits high modularity.
    - *All the different transport modes can be linked through the MaaS app. New offerings can be added relatively simply because of the standardization using the Transport Operator Mobility-as-a-service provider Application Programming Interface (TOMP API).*
- if its components can be combined easily and flexibly integrated at a low (transaction) cost
    - *This is just what the MaaS app does: combining components (transport solutions) easily and flexibly integrated by the MaaS app of the MSP based on the standardized interface (TOMP API) at low transaction cost: this is exactly the assignment of the MaaS Service provider.*
- AND close coordination among the components clearly benefits the customer.
    - *The close coordination among the components by the MaaS app results in seamless planning, booking, billing, and paying benefitting the customer especially when his travel requirements are considered with the selection of the transport solutions offered (i.e., fast, low carbon emission and minimize the change of modalities).*

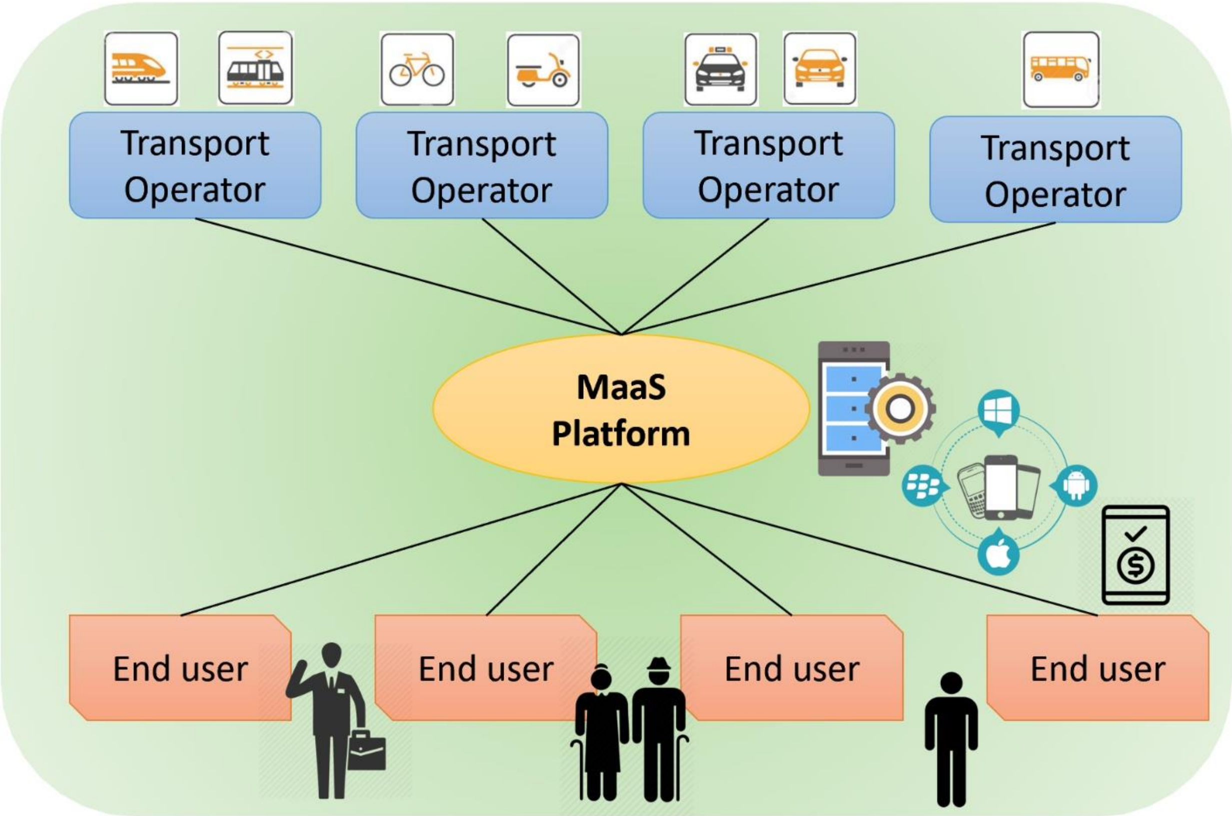

Figure 9. *Schematic depiction of transactional MaaS ecosystem*

Figure 9 illustrates how MaaS can be considered as a transactional ecosystem. The ecosystem for MaaS is still in its early stage of development. There are many different players in the ecosystem, that interact with each other in their product offering through the MaaS app with the end-user (the traveler), based on all kinds of different contracts (permits, concessions) and conditions set forth by the public governance. This happens in an environment with a high level of innovation both technically as well as in the product concepts offered (i.e., Micro mobility solutions). All these interacting players in a changing context make it hard to predict the result of a specific action. Exactly that is the reason why I&W started the seven MaaS pilots. The pilots create a learning environment for the further development of MaaS as a concept and MaaS functioning in an ecosystem. The ultimate goal is to scale up the regional pilots to the national level.

This research did not investigate all the components of the ecosystem but focused on the subsystem of Mobility providers, Government, and MaaS Platform as indicated in figure 10 below.

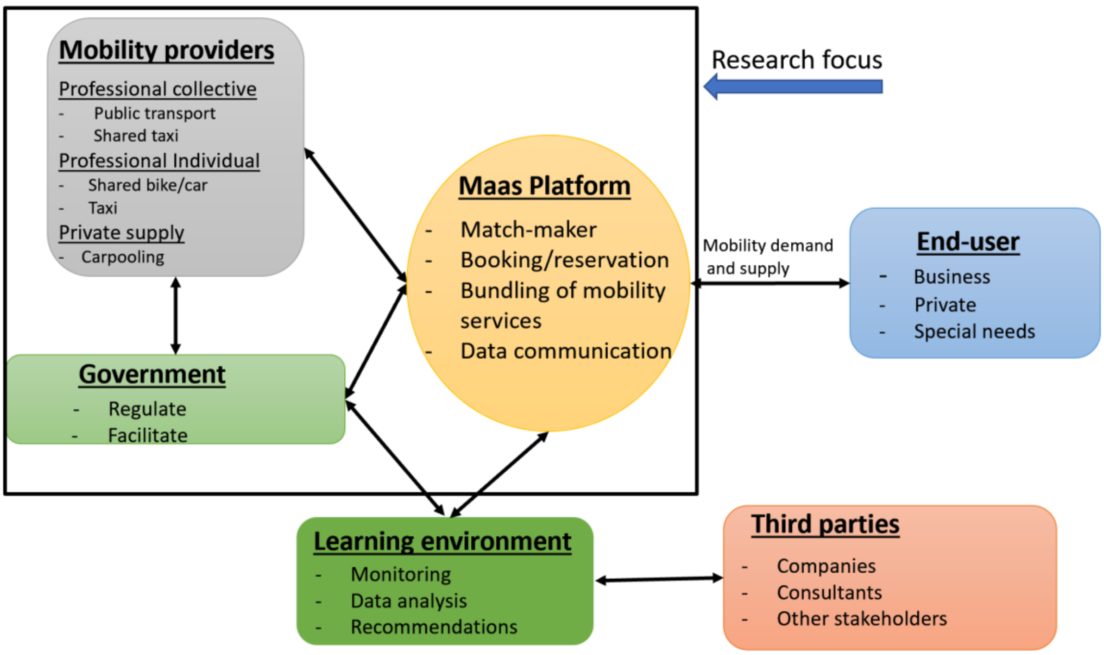

Figure 10. *Depiction of MaaS ecosystem and the focus of this research based on Muconsult (2017)*

Figure 10 Is a schematic depiction of how the MaaS ecosystem is currently being set up in this pilot. As you can see this research focuses on the Government, Mobility providers, and the MaaS platform. The decision to apply this scope to the research is because the MaaS ecosystem is at a very early stage. At this point, the MaaS platform is not yet being offered to the end-user (except for Utrecht) and is not yet providing data to the learning environment in any of the pilots. Interviews however were conducted with members of the learning environment to better understand their role in the pilot these were however not included in the coding process.

5.2.3 Corona

At the very start of this research, the severance of the corona pandemic started to become known. Shortly after, significant measures were taken by society and the government to mitigate the impact of corona on citizens. Measures such as social distancing and locking down the country were taken. The extent of the impact of these measures has also extended to the (public) transport sector namely because of the advice by the government to travel as little as possible and to only use transport services for necessary travel. This had a huge impact on the Dutch mobility sector as the demand for public transport decreased by more than 50% and at some point 90% (Lonkhuijsen, 2020). One of the interviewees mentions that at some point the public transport companies were merely ‘Moving hot air’. Besides the transport sector as a whole, the pandemic has also had its impact on the pilots in particular. The main impact it had on all the pilots as mentioned by all the interviewees is that the initial planned launch of the pilots was significantly delayed. The interviewees explain that it would not have made sense to promote this new mobility concept when the government is actively discouraging the citizens to travel. Besides a delay to the pilot launch, the decreased occupancy rate of the mobility sector resulted in the need to adjust the goals and targets that were initially set. Furthermore, it is mentioned that it caused a lot of uncertainty for the stakeholders causing them to reassess their priorities, slowing down the progress made within the pilot.

Besides the negative effects of this pandemic, several interviewees also mention positive effects. For example, the pilot delay is seen as an opportunity to improve the initial proposition toward the customer as there is more time to refine and add functionalities. As one of the interviewees mention: *"You never get a second chance to make a first impression"*. Another positive effect that is mentioned is that the pandemic causes an increase in the use and availability of shared mobility, which can contribute to the diversity of mobility supply in the MaaS ecosystem.

Overall, it is hard to quantify the effects of corona on the pilots. It did however become clear that it influences the pilots in several ways. Because of this influence, the decision was made to include corona as a category in this research. Regarding its effect on pilot success, it can be concluded that in the short term it has negative effects because of delays and the (expected) decline in public transport/MaaS usage but for the longer term, it may be an opportunity as mobility behavior is changing and the initial MaaS proposition towards the end consumer.

5.2.4 Policy

Policy is the major tool the government (on national, regional, and local level) has, to create the proper condition for the MaaS ecosystem. The policies interfaces with many critical elements in the ecosystem that no other stakeholder can realize. Examples of these are rules for competition, spatial planning, regulation such as privacy and safety. Since policy can have such influence on various aspects within the pilot, it explains why policy and policy making is mentioned frequently and extensively in the interviews. As policy encompasses many elements, the category policy is sub divided into specific aspects below.

Policy and Regulation

In the introduction it was explained that several important areas with regards to the MaaS ecosystem can only be regulated by public governance as no other stakeholder in the MaaS ecosystem has the right means, power, or the position to govern and regulate these areas.

The public governance defines general policies with regards to the goals they are striving for in the areas of sustainability, safety on the roads for all participants in traffic, the livability of towns and townships, affordable public transport, etc. These policies must be translated into permits, licenses, regulations, etc. to implement the general policies in practice.

Based on the interviews it becomes clear that 4 areas are key for the MaaS ecosystem:

1) Spatial Planning
2) Market Organization
3) Digital Regulation
4) Consumer Protection

This study elaborates on points 1, 2, and 3. Because of the generic nature of point 4) Consumer Protection, it will not be directly included in the policy analysis. As travelers can be considered as consumers of the transport services offered within the MaaS ecosystem, they are protected by consumer protection laws and regulations that apply to all consumers of products and services.

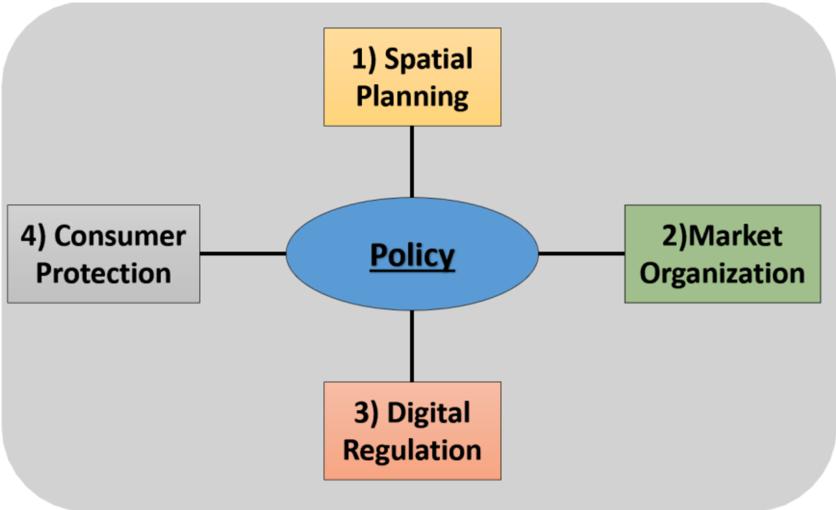

Figure 11. *Key policy areas relevant for MaaS*

1) Spatial Planning (SP)

The monopoly on SP rests with the (local) government and no other stakeholder is in the position to decide on how the physical space will be shaped. SP is very relevant for the successful implementation of MaaS. Several interviewees point out the importance of SP with regards to MaaS. Especially the addition of (new) shared mobility solutions into the public space is important: for example, (e-) bikes, (e-) scooters also referred to as micro-mobility solutions. These solutions are especially important for 'the last mile' trips for travelers to get very close to their end destinations. All these micro-mobility solutions need space in the public area either in specific hubs or free-floating (leave the means of transport wherever you want as long as it is within the boundaries allowed of the designated area).

In all pilots, interviewees refer to the concept of 'hubs'. A hub in the context of MaaS is defined as the effective center of an activity or network. Hub is a place where different types/modalities of transport come together, and people can change from modality. For example, getting off the bus and taking an e-scooter for the last mile. Or vice versa: you leave your shared e-scooter at the hub and can directly take the bus for a longer leg of your trip.

The hub does not only require sufficient space to be allocated to park the means of transport, it also requires an infrastructure for example of electricity to load e-bikes and e-scooters, parking supports, road signs, or other signs to indicate where the hub is and how to use it. The local government is the only stakeholder in the MaaS ecosystem having the power to realize this or to have this realized. They have a monopoly on public space and can regulate how the public space is used. As the capacity of a hub has its limits, only a limited number of players will get access to it. The local government can support the MaaS ecosystem by imposing rules to the user company of the hub like for example that they need to use the standard for data exchange so travelers can book on the open platform. The TOMP API is the standard for the seven pilots.

SP can vary considerably depending on the characteristics of the space: In cities, the challenge is how to go allocate limited space and free-floating concepts can be used. In the countryside space is not the problem; the challenge is where to create hubs with sufficient traffic close enough to sufficient travelers. Free-floating concepts for e-scooters, bikes, or e-bikes usually are not feasible due to the relatively low number of users in a bigger area.

On the regional level (often provincial level) public transport is tendered by the provincial administration. They also can use their monopoly power through the tendering process and the permits to require mobility providers to do a number of things that enhance the MaaS ecosystem. Interviewees mention the obligation to use open standards like the TOMP API or allow other mobility operators to use part of their infrastructure. (For example, taxis that can pick up passengers at the bus stop).

Policy making with regards to the public space, in other words, spatial planning is a critical tool for policy makers to support the creation of a viable MaaS ecosystem.

2) Market Organization (MO)

In The Netherlands MO is the responsibility of the Authority for Consumers and Markets (ACM). The ACM is charged with competition oversight, sector-specific regulation of several sectors (including the transport sector), and enforcement of consumer protection laws (Consumer Protection). Their objective is to ensure that markets work well for people and businesses. ACM enforces the rules that apply to businesses by combating unfair practices by promoting compliance with the rules. ACM provides information and guidance so that everyone knows the rules and can exercise them. (ACM, 2021b)

Since in the public transport sector competition does not naturally exist, additional rules are imposed to promote competition and create a level playing field for companies who want to enter such markets. For example, by using tendering processes for allocating long-term transport concessions combined with performance guarantees to assure proper performance usually created by sufficient competition.

Although MO is determined at the national and European level, it also provides a policy tool in the hands of the regional and local administrations as they can apply the rules and regulations to suit their specific policy needs and requirements. For example, competition is created in the tendering process for a transport concession. The province or city can add specifics enhancing the MaaS ecosystem in the tender document like the obligation to link to the TOMP API or accepting changes to the concession contract based on innovations that cannot wait till the end of the concession that last often quite long. Ten years is a normal period for a public transport concession.

Some of the interviewees refer to the inflexibilities of long-term concession contracts for example to integrate innovative solutions. This inflexibility can create barriers for the MaaS ecosystem. Public transport is a key part of the MaaS ecosystem for transport on local, regional, and even national level. It is very important to recognize that public transport is a real capacity solution able to transport many people at the same time over long distances efficiently and sustainably. It provides the backbone of the physical mobility system. Linking shared mobility solutions to those parties can be difficult.

Another challenge identified by interviewees was that some of these big players like NS or bus companies do not strive for an open MaaS system but strive for a MaaS system that they specifically offer to their customers. No or hardly any other suppliers of MaaS services are allowed to use their ‘wheels’ or can only make use of their wheels against unfavorable conditions (price discrimination). This can lead to suboptimization of mobility solutions offered and monopolized solutions around long-term concessions operated by just one player. This can be referred to as a winner takes all scenario, where the concession winner has a natural monopoly on public transport in a region or regions. This is an unwanted outcome for MaaS. Open standards and access to mobility capacity for MaaS providers are important to optimize the use of the available transport capacity that is (partially) financed with public funds. Policy makers should prevent this from happening using the rules and regulations set out for this sector.

Not too many details were provided by the interviews about this subject as the competitive part took place in the early phases of the pilots in the tendering process.

3) Digital Regulation

Another area where policy makers have handles to determine or influence the MaaS ecosystem is the important digital part that is crucial to MaaS. Only through digital real-time communication, MaaS can offer real-time options to travelers of different modalities of transport.

An often-overseen factor for MaaS solutions is the constant availability of mobile internet connections or real-time solutions for travelers. This study will not further elaborate on this factor, but it might be the case that in remote areas coverage is not reliable. This would hamper the use of MaaS.

Interviewees mentioned that the different MaaS Service Providers (MSP) must use a standard protocol assuring all users of the system (travelers, MSP, mobility operators, …) can exchange data to create one system covering all the requirements of MaaS. Standardization provides a solution here. In the pilots, this is the TOMP API, which all the participants need to use to assure effective and efficient exchange of data. In the tendering process, this has been mentioned as an obligation to adopt this standard. Mobility providers who want to link up to the MaaS platform will need also to adopt this standard to create a well-functioning ecosystem for MaaS.

Another area that requires proper regulation or organizing is the area of privacy and privacy protection of the travelers and proprietary company information. The AVG legislation creates the European and national set of rules with regards to Privacy. This needs to be implemented in the contracts and agreements between stakeholders in the MaaS pilots to assure these rules are followed.

Interviewees indicate that the integration of standardization and privacy protection is a condition sine qua non for the MaaS ecosystem. Data exchange and data communication standardization assure MaaS to function as one solution for the traveler using different modes of transport. Travelers must be assured that privacy is guaranteed. Doubts about privacy can severely damage the MaaS ecosystem.

Relationship between policy making and innovation.

The development of MaaS and the ecosystem for MaaS innovation play an important role. Technical innovations like the TOMP API, data communication, data sharing, new shared mobility technology, localization technology, infrastructural innovations such as the creations of hubs for shared mobility, innovative ways of cooperation between parties involved in MaaS, etc. Policy making is lagging behind the developments created by innovations. This is well illustrated by Airbnb in Amsterdam. What started as a nice new innovative proposal to share houses, became such a huge success with negative consequences for the city e.g., too many tourists at the same time and a decrease in the availability of houses for residents of the city because an increasing part of the housing supply was absorbed by Airbnb users. Policy is often developed in response to a situation getting out of hand to remedy unwanted side effects. Considering the innovative character of MaaS as well as the impact MaaS has on public space and the users of public space in many aspects, it is crucial to prevent remedial policy-making correcting situations after they got out of hand. This slows down the process of incorporating innovative solutions in day-to-day practice. Therefore, it is important to try to keep the time between implementation of the innovation and the policy-making short enough to keep the innovative process going instead of stopping it to first remedy negative side effects. This can be accomplished by closely monitoring the innovation's development in practice and the impact it creates.

The use of traditional policy making tools for a dynamic ecosystem

The development/construction of the seven MaaS Pilots is done with the classical policy making tools such as the program of requirements (programma van eisen), framework agreements (raamovereenkomsten), contracts, service level agreements, project managers and contract managers, periodical meetings, etc. to create a blueprint of the desired outcome and trying to rule out all the risks. Almost all interviewees report on problems they encounter with regards to the interpretation of the contract, disagreement with other stakeholders, contract not covering every situation, surprises, etc. This is not surprising if you realize that MaaS functions in an innovative ecosystem, which is a dynamic system developing over time with unexpected interactions between the actors in the system. The traditional policy tools as mentioned focus on managing and reducing the risk to the lowest level possible. This works counterproductive within an ecosystem where many things are not exactly known, and the development is dynamic. The application of the traditional policy tools hampers the dynamic development of the ecosystem. The problems mentioned by the interviewees are considered as the result of this mismatch. The dynamic and innovative character of the development of the MaaS ecosystem requires a better-fitting policy-making process or at least a process considering the dynamic and uncertain character of it.

Another observation made is that the development of the ecosystem should be made with the end-customer in mind. MaaS can be perfectly tailored to the needs of a specific target group, creating different service proposals to those specific groups instead of a one size fits all approach. Much of the behavior of MaaS users is still unknown and a lot is to be learned during the operational period of the MaaS project. To maximize the learning in a dynamic environment, an approach with short learning and improvement cycles is advisable. Common techniques such as Agile[1] provide good opportunities to apply during the implementation of the project.

5.2.5 Resources

Resources can come in many forms; in this research, the focus will be mainly on financial resources and (access to) the public space. Before resources are allocated, a clear policy has to be developed. A policy will form into a concrete plan and for the implementation of the plan, resources are required. The category of resource is of interest to this research as the allocation of resources can influence different aspects of the pilot making it a management tool.

Financial resources

Through the interviews, the main resource that is discussed is financial resources. The allocation process of these financial resources plays an important role in accomplishing desired results. By allocating financial resources to the right stakeholders or on the right aspects of the pilot the allocation may result in increased success. Within the pilot, you can observe where these financial resources are allocated and whether these financial resources suffice according to the interviewees. There are mixed views on the question of whether there are enough financial resources allocated to the pilot in general and differing opinions on whether the allocated financial resources are used effectively. One of the interviewees mentions that before accepting the tender the availability of financial resources is clear to the stakeholder, meaning that when they accepted the tender, they decided that the allocated financial resources were acceptable. On the other hand, it is mentioned that the stakeholder which accepted the tender has accepted the tender, not for the available (limited) financial resources but because it aligns with their existing business strategy. Furthermore, the impact of corona also seems to increase the need for additional financial resources.

Another important aspect of the allocation of financial resources is to the project managers and contract managers, as they are important influencers of the ecosystem. Enough budget must be available for them to work without budget constraint for the time they need to invest to make the pilots/MaaS successful. Some have mentioned that at least at the beginning of the

[1] "In general, agile methods are very lightweight processes that employ short iteration cycles; actively involve users to establish, prioritize, and verify requirements; and rely on tacit knowledge within a team as opposed to documentation" (Boehm & Turner, 2003, p17)

process only a limited number of financial resources were allocated regarding the number of hours that they felt that they were required to work. As these stakeholders play an important role in the ecosystem it would be worth considering an increased financial allocation to compensate for increasing work hours.
Another important argument made by one of the interviewees is that in consideration of the impact the pilot and eventually the larger implementation of MaaS will have, the allocated financial resources are extremely little. It is portrayed that investments of billions can be prevented in infrastructural projects by optimizing the existing infrastructure utilizing MaaS. Furthermore, several interviewees mentioned that considering the delays as a result of the corona pandemic, increased financial resources are needed to compensate for extra costs.

When discussing the allocation of financial resources to stakeholders within the pilot/MaaS ecosystem, one critical party seems to be left out: The Transport Operators. The transport operators are the actual providers of mobility to the end-user. It is mentioned that even though they are expected to implement API standards, (very) limited financial resources are allocated to them to be able to realize this and be motivated to do so. As this API standard implementation is very important to the success of the pilot and the ecosystem as will be described in 5.3.1, transport operators must be motivated to implement this standard. They may be motivated and aided to do so by allocating (more) financial resources to them.

In more general terms it should be noted that public transport in The Netherlands is subsidized with financial resources from the government. For example, the Dutch taxpayer pays 45.2% of the bus ticket of each bus traveler (ACM, 2021a). See figure 10 for more detail on the resources provided by the government to the different public transport modalities. For MaaS the public transport is a key element for scaling up MaaS to the national level because public transport constitutes the backbone for interregional and national transportation in the Dutch transpo

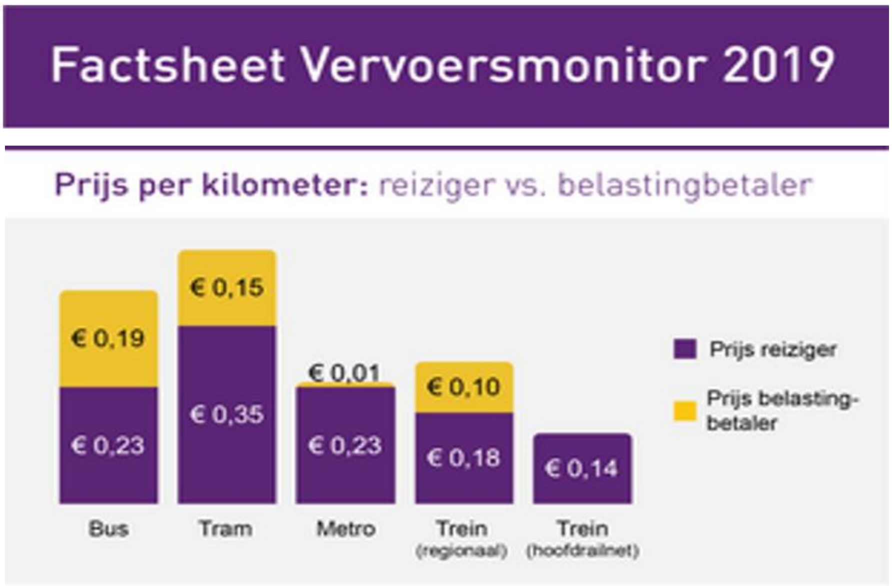

Figure 12. *Public financing of public transport by type of public transport (ACM, 2021a)*

Spatial planning, the allocation of public space

As explained in the policy section, spatial planning is a resource that can have a significant influence on the success of MaaS and the pilot. When public space is for example allocated for the development of hubs, dedicated parking spots etcetera, it can provide opportunities for the (micro) mobility providers. Besides the opportunity for the mobility providers, dedicated areas for mobility allow for easy transition between modalities and make the area recognizable for travelers easing the access to mobility. As the allocation of public space can only be regulated by the (local) government, the allocation process could be utilized as a strategic tool to accomplish certain goals. For example, by only giving permits and concessions to utilize this public space to mobility providers when they use TOMP API and connect to a MaaS initiative. Many of the interviewees mention, that incentivizing or even forcing mobility providers to use the TOMP API standard through concessions and permits is beneficial for the MaaS ecosystem as a whole. It is pointed out however that current permits and concessions that have been issued could hamper the speed of the transition for the existing players as these tend to be based on agreements of 5-10 years. Overall an increased allocation of public space for mobility initiatives would increase the success and adoption of MaaS by people by giving them more flexibility and access to modalities. And when MaaS gets adopted by more people, the objectives like decreasing the number of cars in a city can be realized.

5.2.6 Standard Setting

Standard setting is an important factor to create a successful ecosystem. Especially the standard necessary to assure all parties (transport operators, MaaS Service Providers, end users, government, common data providers, weather info, traffic info, and transaction processors for payments) are connected through the app, to create a coherent process of planning, booking, ticketing, billing, and paying for the trip. The standard must assure that all parties involved in this process can interact seamlessly with one another. Without that flawless connection, MaaS cannot function properly. The standard must assure that the flow of information between the parties in the ecosystem runs smoothly. The standard is also important to link new transport solutions or new transport operators easily to the network. So, the standard must create a low barrier to become part of the network. The standard must be open to assure many different types of parties can join. The open standard creates a level playing field according to interviewees. It is the objective of I&W to prevent one big player (for example Google) to create its standard, link all transport operators and MaaS Service Providers to that standard and thereby potentially monopolizing the market and keeping out other parties. This danger is also referred to as the winner takes all risk and could also come at a cost for society.

For that reason, for the seven MaaS pilots, the standard-setting is based on the open TOMP API (Transport, Operator MaaS Provider Applicable Programming Interface). It standardizes the interface between MaaS-providers and Transport Operators, taking the whole chain into account. For the reasons mentioned above the TOMP API is set as the standard and the

participants have input to the further development of TOMP. The TOMP API 2.0 is expected to be ready in early 2021 (Toolen et al., 2020).
The interviewees mention the following critical points concerning TOMP API:

- The standard setting with TOMP should not go too far, as over-standardizing leads to a barrier to innovation, or forces services provided to be very similar. These would be 2 negative effects of standardization that has gone too far;
- The demand for Transport Operators to use TOMP forces them to invest in making their system TOMP ready. This requires investment. Acceptable for bigger Transport Operators, but probably too big an investment for a small Transport Operator like a hotel with 25 bikes. Also, a lack of technical knowledge might stop the small operator to be part of the MaaS ecosystem. Technical assistance and financial support are required to eliminate the barrier;
- It is important to enforce the use of TOMP. This can be realized through transport contracts, concession, permits, or by providing financial incentives (i.e., For the small players to link up to MaaS by using the standard of TOMP).

Another formal standard set forth for the seven pilots is the accessibility of the user apps in terms of readability for people with bad sight or blindness or people with reduced motor skills. Inclusiveness is an important requirement for MaaS.

Further standard-setting or standardization can be very effective for the contracts used between the stakeholders in the MaaS ecosystem. Think about the standard contract developed for renting a house. By the experience developed, the contract transparently considers all relevant factors. The objective is to minimize conflict forcing parties to go to court because all (or almost all) relevant elements are included in the standard contract. The use over time creates case law and if necessary, the standard is updated and improved. This mechanism is also beneficial for contracts between parties in the MaaS ecosystem.

Lastly, is the standard-setting with regards to Privacy. Two years ago, new privacy legislation has been introduced in Europe. In the Netherlands, privacy is worked out in detail in the standards outlined in the AVG (Algemene Verordening Gegevensbescherming) This can be regarded as a standard that needs to be followed. For the MaaS ecosystem, this is a huge challenge to assure the privacy of its users. Next to the data protection for consumers, also company data requires sufficient attention for companies acting in the MaaS ecosystem. A standard protocol will help to assure this.

5.2.7 Data Sharing

The availability of data and the present capability of real-time processing these data, create the possibility to develop services like MaaS. Data by itself does not create a lot of value. By combining data and processing the data, valuable information can be created. The digitization of society in the last two decades has increased the access to data and the processing of it enormously.

The MaaS service providers (MSP) receive data to perform their primary function to enable travelers to plan, book, bill and pay for the services provided. Next to that, the result of all the travel movements constitutes a very valuable database to analyze travel behavior, measure success, investigate how to influence travel behavior by adapting pricing, etc.

The MaaS pilots have as a major objective to create a life MaaS experience and learn from this experience by creating knowledge to successfully implement MaaS on a wider and bigger scale. For this the collection and processing of data from the pilots are indispensable.

With data and data processing there are always 2 contradicting interests:

- For learning and knowledge creation purposes the more data available and data processing, the better;
- For privacy reasons and to protect the interests of companies or institutions the fewer data available constitutes the better solution.

For these reasons, data sharing needs to be regulated diligently by the right party to create the optimum balance. Several of the interviewees have mentioned this tension between trying to get as much data as possible for the learning and as little as possible to protect individual privacy and company competitive sensitive information. They also mentioned that managing this delicate balance is quite difficult.

As data sharing between parties is vital to learn from the pilots, the ministry of I&W has included in the frame contract (‘Raamcontract’) that all MaaS pilot participants share data. Detailed protocols will state which data need to be provided to get sufficient data to create the intended learning experience. This is agreed upon between the pilot participant and I&W in a Data Transfer Agreement (DTA).

At the same time, the frame contract states that the rules to protect the privacy of the individual traveler (The AVG) must be abided by. This is regulated through specific contracts between the parties describing in detail for what purpose it is used, which data are used and how, and how long the data will be kept in a database to name just a few important elements of these contracts. All parties must be aware that there is a host of very privacy-sensitive information involved including the possibility to track the travel behavior in time and place of each individual and for WMO mobility also medical information is shared. The regulation of the data-sharing process is very important for the MaaS ecosystem. They constitute the ‘traffic rules’ within the ecosystem, assuring the proper functioning of the ecosystem by regulating the flows of data for the functioning of the ecosystem as well as the creation of knowledge by aggregating and processing the data and the protection of privacy and company interests related to the data sharing.

The contract managers manage the execution of the MaaS pilots and in this role, they also need to see to it that data is shared as well as check if this is done according to the rules agreed in the contract and DTA as well as according to the. If any party in the pilot suspects something is wrong with regards to the data sharing process, they can report this to the contract manager, who can act on that. Although the learning environment for the pilots is outside the scope of this study, it is relevant to this section, as the data of the trial is stored in a database in this learning environment. To assure access to the data or part of the data this database is kept and managed by TNO. TNO is a public-law organization with an independent position. With this construction data storage and distribution are managed. By anonymizing and pseudonymizing the data, it can be safely used for research without jeopardizing the privacy and the competitive position of companies.

An important element of data sharing is the sharing process. For the ecosystem to work well, data needs to flow easily and in real time between the traveler, MaaS Service Provider, and the Transport Operators. To speak the same language, a standard is set for the pilot project. This standard is the TOMP API. It is an open-source protocol assuring all the different systems used by the parties in the MaaS ecosystem can safely exchange data. The TOMP API is designed with safe data interchange in use. See section 5.3.6 Standard Setting for more details about TOMP API.

5.2.8 Coordination and communication

Just as important as the policy-making instruments are (e.g., the program of requirements, framework agreements) or the working methods use (e.g., blueprint approach vs agile approach) the role and the performance of the managers in the pilots require specific skills other than the skills of traditional public contract managers. The contract managers' role performance can make or break the success of the implementation of the MaaS solution in the pilots as well as a contract manager in the scaling up of MaaS solutions. Perfect tools and a perfect method wrongly applied or executed will increase the likelihood of failure considerably. In other words, contract managers play a crucial role.

For MaaS to be successful, a good working ecosystem is required. The ecosystem is complex due to the number of different stakeholders with different goals, differences in the size of the stakeholders, technology is developing quickly, continuous innovation is taking place and new possibilities create opportunities for end-users (travelers) that need to be 'sold' as solutions to the traveler or group of travelers. All these interactions and uncertainties require contract managers able to coop with these circumstances, especially in the pilot phase of MaaS implementation.

One of the interviewees mentioned that indeed a contract manager is required not a contract custodian. The contract custodian sticks to the letter of the contract and takes the position vis-a-vis the suppliers of the MaaS proposition as: "You just have to deliver with regards to content, budget, and quality, and if you don't, we will keep you the contract with what is described in the contract." This approach creates a high level of formality in the process, forcing all parties to try to minimize risk. Minimizing risks reduces the speed of innovation and trying new things as everybody will become risk avoidant. Risk avoidance is very negative for the development and trial of new ideas. Sometimes taking risks is necessary to create learning experiences and improvements for the ecosystem and the innovation process. This also assumes that almost everything can be properly described including measures in the contract. This is not the case in learning pilots for a new concept as MaaS where still a lot is in a developmental stage and the ecosystem has to be built.

Contract management requires to consider and promote innovation development and learning experiences. The contract manager as executor of the policy needs to try to explore the innovative side of the pilot and this requires another approach of the policymakers compared to the business as usual. According to some of the interviewees, it is a process of innovative co-creation where the policymaker and executor sometimes function above the parties to make sure the intended goals are reached. Sometimes policymakers are the partners working alongside the other stakeholders in the pilot to cope with unforeseen challenges. One of the interviewees referred to this double role by mentioning he had to coordinate between local governments and the province and at the same time with the MaaS Service Providers and the mobile operators. All parties are required for progress. This role view was not considered the same in the different pilot projects. This is an important point of attention to find the right role execution. The combination of the right policy tools and the application of those tools by the contract managers are important factors of success to consider.

5.2.9 Scalability

One of the main goals set forth by I&W is that the pilot is scalable, as the intention is for wider (national) adoption. The extent to which this pilot is scalable and what possible hurdles might be in this process has therefore been selected as a measurement of success.

Several aspects can enable or hinder the scalability of the pilot. During the interviews, all interviewees agree that the pilot is scalable. They do however point out different aspects that are of importance to realize scalability at different levels.

One of the most important aspects as mentioned by many interviewees is the interoperability between different stakeholders. The TOMP API as described before can play a vital role by serving as a unified language allowing different (new) stakeholders to ‘plug-in’ to the MaaS ecosystem. As was portrayed in 5.3.6, setting standards like the TOMP API but also other standards such as standards for legal documents and agreements, can contribute to the ease of scalability of MaaS.

As the initial goal is to make the pilot scalable on the national level, it is important to point out the opportunity of existing national stakeholders. Big support for scalability is the already existing network of public transport (trains, buses, metro, trams, etc.) to a certain extent this network operates in a coordinated way, and payment is done using one payment system: OV-Chip card. For the MaaS ecosystem on a national level, public transport needs to be integrated into the MaaS system. This way an MSP can integrate the public transport offering in its process of planning, booking, billing, and paying. As these existing national stakeholders are already operating on an interregional level, they can also form the backbone in adding transport operators on the local levels.

The sharing of knowledge can also play a very important role in scaling up the MaaS ecosystem. When municipalities or other stakeholders that are not yet part of the MaaS ecosystem are provided with clear guidelines and for example checklist with Do’s and Don’ts, this could have a very successful influence on the wider adoption of MaaS.

Limitations

During the process of scaling up, there may be some aspects that are limiting the scalability of MaaS. It is mentioned that it could be challenging, especially in the earlier stages to attract transport operators to reach critical mass. Some of the interviewees mention that once transport operators comply with the API standard, price discrimination could pose a significant hurdle. For example, certain transport operators may be willing to participate in the ecosystem by using the TOMP API. They however may only provide very high tariffs, disincentivizing customers to use the MaaS platform but to use their services directly. This form of price discrimination can be very challenging as the added value of MaaS is ease for travelers. When travelers continuously need to check each mobility provider for their separate (private) proposition, a lot of the added value of MaaS is discredited. This has a lot to do with the conflicting interests of different stakeholders. This hurdle must be overcome, possible mitigations for this hurdle are making agreements before allowing transport operators on the platform.

Scaling up eventually would also be cross border and this is already part of the scope of some of the pilots. Interviewees however mention possible limitations, such as interoperability. Our neighboring countries for example may hamper interoperability because of technical limitations. Some cross-border stakeholders, for example, do not utilize electronic ticketing systems, making it currently hard to provide their propositions on the MaaS platform.

5.2.10 Knowledge

The major objective of the MaaS pilots is to gain experience and knowledge about how to create and run a successful MaaS ecosystem. The reason for doing this by running seven pilots is that a MaaS ecosystem (like almost all ecosystems) is a complex set of interactions with many different parties interacting and influencing each other. The MaaS ecosystems operate in different environments: cities, countryside, different target groups, different levels (local-regional-national). Many variables are involved. A pilot provides a simulation of MaaS under real-life circumstances. Setting up a MaaS ecosystem in real life will help identify barriers, do’s, don’ts, best practices, critical success factors, etc. All the acquired knowledge from the pilots will create a basis for scaling up MaaS on a national basis. One learns how to successfully create the right conditions for a viable ecosystem for MaaS. Learning is the major objective of running the pilots.

Knowledge can be regarded as an end-product of ‘doing’ the pilot. There are both qualitative as well as quantitative data-creating knowledge. The major challenge is how to make the acquired knowledge accessible to maximize the learning effect. This is especially the case for most qualitative knowledge. The interviewees indicated that in the phases before going live, most of the knowledge created results from the meetings between the people responsible for setting up the pilots. They meet on a regular basis in different settings. They exchange experiences and share knowledge. Most of this is written down in reports, minutes of meetings, whitepapers, etc. made available to the parties involved in the pilots. However, this information is not categorized or made accessible in a later stage for other people who were not present during the meetings and did not directly get the reports, etc. In other words, there is no metadata available to make this valuable knowledge accessible later on. Also, when new people enter the pilots, it is hard to pick up the information in a structured way. This can be circumvented by creating periodical evaluations and reporting what went well and what could be done better including the learnings from that. This applies to the phases of setting up the pilot, the tender process, getting all parties aligned before starting up to the going life of the project.

As the pilots go life, the quantitative data starts to flow and the learning environment is being filled with data: number of people downloading the app, number of users of the app, number of trips per user, frequency of using what transport operator or modality, who are the users (age, sex, goal of transport, etc.). Once the database is filled with these kinds of data knowledge can be built by analyzing all these data of course taking into account the privacy rules and the company sensitive information of the participating companies (TO's and MSP's). The interviewees indicate they are looking forward to the output of the learning environment. This however is not yet the case as many of the pilots have been delayed because of the Corona pandemic and the data collection has not started yet.

The actual start of the pilots in practice also is the source for data collection of experiences of the users of MaaS. Not only the travelers but also the experiences of the other parties involved in the pilot like the transport operators and the MaaS service providers. These are three important stakeholders in the pilots, whose experiences are key to the success of MaaS and the MaaS ecosystem. The collection of data through structured interviews and regular surveys will create additional insights and knowledge for how the MaaS pilot and the ecosystem are doing and identify factors promoting or discouraging the developments. One of the interviewees said: *"The proof of the pudding is in the eating!"* and that is what almost all people involved in the pilots are waiting for. This still had to happen at the time this study was realized.

Two barriers were explicitly mentioned during the interviews. One was that the companies involved were worried about the sharing of competitive data and assuring this would not happen. Another comment was that for political reasons the pilots were being hyped by creating high expectations for success. Consequently, the pressure for a pilot not to fail is high, even though the objective of the pilot is to learn and to build knowledge. This also implies that it can fail. Also, from failure knowledge is acquired and learning experiences are created.

5.2.11 Stakeholder Satisfaction

Stakeholder satisfaction can be regarded as a way to quantify the success of the pilot. This can be done by identifying the goals of the stakeholders and to what extent these goals are met. When their goals are met this can be an indicator for (their) success which may contribute to pilot success and the wider adoption of MaaS. The main identified stakeholders are: The MSP's, the public administration at different levels (local, regional, and national), TO's, and not to be forgotten; end-consumers which will be elaborated on in the section below. As these are stakeholders within the ecosystem it is important to identify overlapping interests that contributed to their symbiosis.

One of the main functions of the MSP's in the ecosystem is to manage the supply and demand for mobility between transport operators and end-users. When they carry out their function of managing mobility demand- and supply, transactions are made on their platform. One of the main goals that influence the success of the MSP, is the handling of these transactions. When many transactions are happening, their business case becomes more viable.

The public administration is organized on different levels namely local (municipality), regional (provincial), and national (central government). These different forms of public administration can have their own specific goals but also overarching goals. One of the main goals of the national public administration for example is sustainability.

On the local level and regional level, the WMO transport can be a specific goal, in the pilot of Twente for example the local/provincial administration has a focus on providing more flexible and cost-efficient WMO transport.

The goal of the TO's can be aligned with that of the MSP. The goal of TO's is namely to have a high occupancy rate of their mobility offerings. This means many travelers utilizing the modality. When this is the case the MSP's goal of handling transactions by connecting between TO and the end-consumer is also met.

The end-consumer will also be an important stakeholder as they will be the ones utilizing the service provided by the collaboration of the abovementioned stakeholders. The end-consumers goals may be different per traveler (group) however in general the need of a traveler is to have flexible and easy access to different forms of mobility for efficient movement.

Even though there are different goals per stakeholder, all stakeholders will benefit from increased adoption of MaaS in the number of users and intensity of usage which will be elaborated on in section 5.3.12. The MaaS product proposal provides another added value and that is that it can be targeted very specifically on target groups or even up to the level of an individual.

MaaS: The ultimate instrument for targeting specific groups

MaaS connects all kinds of transport/mobility possibilities to individual travelers with their specific mobility needs utilizing a data platform. It is real-time and selects the best solution for an individual user or a group of users with specific characteristics, by selecting the different options based on the criteria of the traveler or group of travelers. MaaS solutions must not be regarded as just a kind of entry ticket for all the options of transportation (a super OV-jaarkaart). That would be a misconception according to a number of the interviewees. It is not a one-size solution that fits all. Without any decision criteria, MaaS would generate way too many options and the user would be left with huge choice stress. MaaS makes it possible to develop specific mobility solutions for target groups based on the specific needs and requirements of that target group. And that is a very important characteristic as the mobility product can be focused on the target group.

In the pilots, different target groups have been selected and the aim is to focus the mobility product proposition on the specific mobility needs of the target group. In the trial in Twente, this is for example the people using WMO transport (transport offered by the local government to people not having proper transport, or having difficulties using public transport solutions). WMO transport is currently executed by private taxi companies and is an expensive solution. The effect is that travelers using WMO transport, getting used to this and start to use this type of (expensive) transport as the only option, which is limited up to a budget the traveler receives. MaaS should extend its palette of solutions and also promote other mobility options to the WMO target group, increasing their access to mobility at a lower cost. The conditions, information campaigns, communication strategy, tariff strategy, and financial support to the MaaS platform by the local government (budget responsible for WMO) or by subsidizing certain tariffs can be exactly tailored to the desired outcome. Another illustration given by the interviewees is the target group for business travel. Companies want to offer a commuting solution to their employees as well as for employees traveling for business. The mobility solutions offered can be tailored to the target group (employees) and the goals of the company. If the company wants to reduce CO_2 emission, they can offer transport solutions with low emission levels at very attractive rates to their employees. Commuting means lanes of transport with a high frequency (home-work). This could make it attractive to a mobility operator to give low tariffs per trip because many people use the lane frequently as can be learned from the travel statistics.

Therefore, it is critical for optimal use of MaaS to recognize and define the desires of the travelers as well as the policy goals of the client to tailor the solutions offered to the target group of travelers. Sufficient time and resources (i.e., to conduct market research to the travel needs of the target group) must be allocated to this in the design phase of the MaaS solution offered.

5.2.12 Number of Users and Transactions

For the ecosystem to thrive, users must utilize the service that the ecosystem provides. The number of transactions herein is also important because it is an indicator of the intensity by which users participate within the MaaS ecosystem. As was described earlier in the theory section 2.2 by Pidun et al. (2019); "*value creation can be measured by the number of successful transactions and benefits to both sides of the market"*. This value creation is of vital importance for the MaaS ecosystem and could be considered as the nutrition that makes the ecosystem sustain itself and grow. When there is enough value within the system, it allows for the stakeholders to reach their goals and to make a sustainable business case. The number of users and transactions, unfortunately, had to be taken out of the scope of this research because of the corona delay in the pilot launch. It should however be considered as an important indicator for success in the coming stages of the MaaS ecosystem.

5.3 Concept results and analysis

5.3.1 *Introduction*

MaaS is an ecosystem. Considering the complexity of MaaS as a system of interacting parties that:

- Respond to individual desires of the traveler and
- Take into account specific conditions of the client (employer, government, other policy objectives)
- On a real-time basis
- Having to offer transport services (plan), sell it (book), invoice it (bill), and settle it (pay)
- Within all kinds of policy frameworks of sustainability, spatial planning, target group traffic (WMO), privacy, level playing field, etc.

the governance model of a business ecosystem is very much applicable to the concept of MaaS. This statement has an important implication for the stakeholders in the MaaS ecosystem. The notion of the stakeholders that an effective paradigm of ecosystems to use for the development of MaaS, makes them aware of the complexity of the system and the importance of their roles and behavior in the system as well as their openness to incorporate innovation to keep this young ecosystem developing.

The initial linear model used in chapter 1 (figure 13 below) to depict the relationship between governance factors as independent variables and the success factors as dependent variables is to a certain extent oversimplified and can be developed further based on the results of this research.

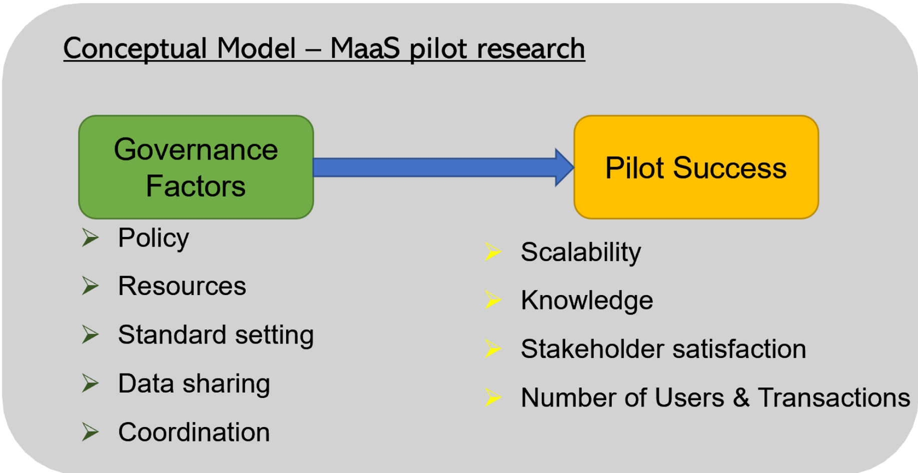

Figure 13. *Conceptual Model MaaS: an oversimplification of reality*

Based on the many interviews held, the complexity to develop MaaS became more obvious, and it explains why I&W chose to use the form of several real-life pilots to develop knowledge and learning about MaaS for the Dutch mobility transition.

The model in figure 14 (p.44) is a better reproduction of reality. The governance factors (see sections 5.2.4 through 5.2.8) provide direction to the development of MaaS, it creates the environment for the MaaS pilots both physically (spatial planning), operationally (rules, regulations, standardization), financially (by providing resources) as well as by giving it direction (objectives to strive for like for example sustainability and less traveling by car). All these factors do not directly influence the pilots' successes. A change in one of the governance factors (independent variable) like for example increasing the variable "Resources" by 1 million Euro, will not translate in an improvement of (for example) 10% of the "Scalability" variable as a Pilot Success Factor. An improvement of the independent variable "Data sharing" by 10% does not automatically translate to an x% improvement of the dependent variable "Knowledge" or in a 2% improvement of the dependent variable "Stakeholder Satisfaction".

The governance factors do have a direct impact on the transactional business ecosystem and the functioning of that ecosystem. The impact can be very specific: for example, in the case of regulating where e-cars can be parked and charged through spatial planning. The focus is on a specific type of transport and transport provider as well as on specific locations in a city. The impact of the governance factors can also be more generic applying to all the companies in the entire ecosystem (transport providers, Maas Providers, employers, etc.). For example, in case of the creation of a level playing field to regulate competition between companies or to assure standardization is applied in the ecosystem and privacy is safeguarded.

Once these described governance factors start to have their impact on the ecosystem, the factors also start to "interact" and influence each other. For example, if sufficient "Resources" (IV) are added to the pilots' ecosystems, this can or will lead to interest and attract:

- Capable Transport Providers building a good supply side of the ecosystem.
- "Users" (or travelers, customers) of MaaS (providing information, incentives, etc.)

Both stakeholders (Transport Providers and Users) are required for Pilot Success measured by "Stakeholder Satisfaction" (DV). If there are no or few capable Transport Providers, not many travelers (users) will be interested in the services provided. Adding "Resources" (IV) creates the right conditions for a capable set of Transport Providers interested to participate in the pilots. "Resources" (IV) also stimulate travelers to use MaaS. The interplay between the stakeholders (Transport Providers and Users/travelers) can lead to a positive impact on "Stakeholder Satisfaction" (DV) and the "Number of Users & Transactions" (DV). However, if the "Policy" (IV) on privacy is not effective, it might shy away travelers leading to a negative impact on the pilots' success (for example lower "Number of users and transactions" and "Stakeholder Satisfaction" both DVs). The ecosystem is the result of all forces exerted on the stakeholders in the ecosystem and the interplay between the stakeholders. The exact outcome (measured as "Pilot Success") of this is difficult to predict.

An operational MaaS ecosystem will produce outputs or results. A number of these outputs/results (the DVs) in this study are defined as Pilot Success (See |Figure 13 and Figure 14) and these success factors can be measured and indicate the level of success. For example, if there are a lot of users and transactions (DV) resulting from the operational MaaS ecosystem, the pilot is successful. If a lot of Knowledge is accumulated based on the observations made and experiences gathered with regards to how the pilot MaaS ecosystem works, this results in a positive impact on the Pilot Succes. However, the success factors measured could also show less positive results. Analysis of the output/results in combination with the observations and experiences made can lead to conclusions and lessons learned about adapting (some of) the independent variables studied: The Governance factors. By changing one or more of the governance factors, the MaaS ecosystem will adapt to the new situation and produce (probably first after some time) different results which are hopefully better. For example, when one or some of the Transport Providers get too much market power in the MaaS ecosystem by starting their own MaaS application, pushing independent MaaS providers to the side, they distort the level playing field. The government now needs to act to prevent such monopolization, or, in other words, to maintain the level playing field for competition. Government can adapt the rules to assure a level playing field for all supplying companies and assure fair competition. This is well illustrated in a recent real-life case. Some big national and regional Transport Providers started their own MaaS platform called RiVier (NS, RET, GVB, and HTM). To prevent too much power to this new MaaS platform (owned by public Transport Providers), the ACM (2021c) made rules prescribing access for other MaaS platforms to the book tickets at the same price level as the Transport Providers could for their own travelers (non-discriminatory pricing). The RiVier MaaS platform is not part of the pilots of this study and is still in development.

It also might be the case that barriers inside the ecosystems in operation are identified. An example of this is when the cost for a smaller Transport Provider to adapt its app to the TOMP-API standard is too high, creating an entry barrier to this company. Examples of these are an e-bikes transport provider in a rural area, or a local taxi company providing taxi services for WMO travel. The barriers need to be eliminated to improve the success of MaaS. A subsidy to these smaller players to adapt their software to the standards set for MaaS could take away the barrier. The impact of Corona is on all three.

The Governance factors “enter” a hotchpotch of interactions between the different parties (stakeholders) involved. This is displayed in figure 14 in the middle by the MaaS Ecosystem. The round-going arrows represent these interactions and interdependencies. The interviewees have pointed out many examples of these interactions and interdependencies.

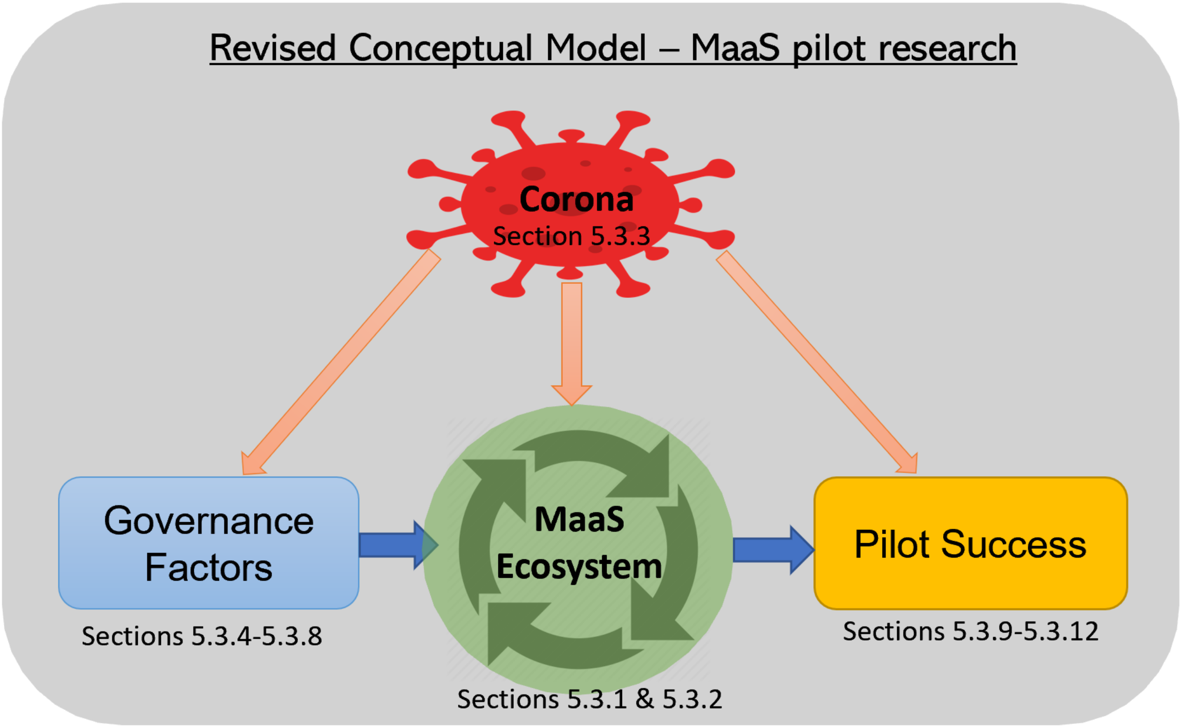

Figure 14. *Revised conceptual model – MaaS pilot research*

The output of the Pilot MaaS ecosystem is the Pilot Success (as described in sections 5.2.9 up to 5.2.12), which has been defined in the objectives to be reached by the stakeholders. Objectives may vary per stakeholder. Since Pilot Success is the output of the complex MaaS ecosystem, it is important to develop measures based on the pilot successes looking back into the 'black box' of the MaaS ecosystem to better understand what causes the success.

During the execution of the pilots and this study, the Corona pandemic showed up unexpectedly as a confounding variable, having an impact both on the independent variables, the governance factors, on the dependent variables of the pilot success, and the MaaS ecosystem itself (see section 5.2.3). Corona policies were added to the governance factors (IV's): 1.5-meter distance and seats blocked in public transport are clear examples of that. Also, the ecosystem itself was directly affected: Instead of traveling in public transport, people shifted to individual modes to prevent coming close to other travelers. Transport providers of public transport lost huge volumes of travelers. Finally, the dependent variables (success factors) were impacted by Corona: Travel behavior of travelers changed. Travelers wanted to travel on their own in Corona time instead of using a fully packed train even though it might have a very short travel time. Maas providers changed their definition of success by lowering the minimum number of transactions to call the pilot a success. Also, the time period in which to reach these targets has been delayed.

5.3.2 Concept Governance Factors (GFs)

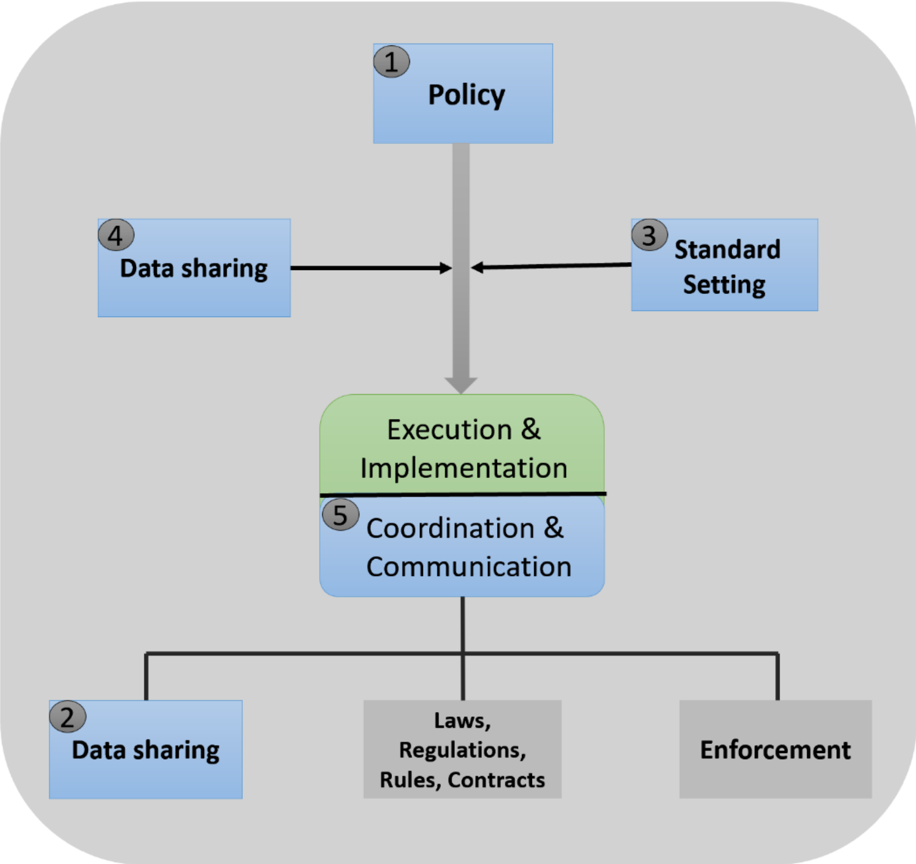

Figure 15. *Schematic depiction of policymaking and implementation process for MaaS with the position of the MaaS governance factors*

Overviewing the 5 GFs from a Governance concept perspective, the factors have different characteristics and vary in level of concreteness and stage in the process to develop a MaaS ecosystem. It is noted earlier that many of the variables having an impact on the MaaS ecosystem can only be decided upon by the government. No other party or body in our society other than the government can decide on law, spatial planning, enforcement of the law, creating a level playing field for companies to compete to name just a few. The government on any level (national, regional, or local) is responsible to take care of these areas. This is realized through **governance** with the ultimate objective to create a society for the benefit of its citizens by making laws, policies, plans, etc., implementing those, and assuring they are followed by enforcing these laws, policies, and plans.

Policy ① making is the highest level of governance in general and more specific for creating the right conditions for the MaaS ecosystem where goals are set, and plans are made and elaborated into policies to be put into practice. The policies developed for MaaS intend that these policies will be executed and implemented. A concrete policy of MaaS defined for the pilots is to reduce the ownership of cars per family. Too many cars will clog the traffic system requiring ever more investments in that infrastructure. An effective MaaS ecosystem can reduce the need for a car of your own, resulting in better use of the infrastructure and less emission of greenhouse gases. These goals defined in the policy-making process will need to be implemented and executed. This is represented by the arrow between **Policy ① and Execution & Implementation.**

Before the policies can be executed 2 important conditions need to be met: **Standard Setting ③** and **Data Sharing ④.** the 2 arrows represent the conditions required for the **Policy①** to be executed. **Data Sharing ④** constitutes the foundation for MaaS. Without sharing data between stakeholders in the MaaS ecosystem, there will be no MaaS. Data sharing is a key factor between the Transport Providers, MaaS providers, and travelers to make MaaS work in order to plan, book, travel, and pay for transport services. Another such condition is **Standard Setting ③**. Standards create rules like traffic rules, making it possible to cooperate in a coordinated way. The TOMP-API standard assures that data can be exchanged between the stakeholders in the ecosystem of the pilots.

The actual execution & implementation of the Policy are done by organizations and people that **Coordinate and Communicate ⑤** while implementing and executing Policy to create a proper MaaS ecosystem leading to desired results. For example, the Ministry of I&W has developed and used a Framework agreement (referred to as "Raamwerk Overeenkomst" or ROK) for all pilots to coordinate between supplying parties like Transport Providers and MaaS Providers. Detailed agreements (referred to as "Nadere Overeenkomst or "NOK") are made in each specific pilot to coordinate the pilots. In these contracts also communication is organized and formalized.

Coordinate and Communicate ⑤ is a critical GF where plans on paper get translated into reality. Those tools are: **Resources** ②, *laws, regulations, rules, contracts* and *enforcement of those laws, regulations, etc*. the latter 2 factors are not described in detail as they fall outside the scope of this research. Resources help the implementation and execution as it lowers barriers for Transport providers and MaaS providers as part of the cost of realizing the pilots are paid by the government through subsidies. Another example of supporting the development of the MaaS trial is to inform the users/travelers or provide them an incentive like the first month for free to entice users/travelers to start using the MaaS services. In figure 15 this is shown schematically.

At the time of realizing this study, the MaaS pilots are getting into the phase of execution, starting to actually run MaaS in real life. In that phase, the travelers will start to travel, and the accumulation of data can start with the objective to see to what extent the objectives of the pilots will be met and how the success factors of section 5.4.3 will score.

5.3.3 Concept Pilot Success Factors (SF)

In the Revised Conceptual Model – MaaS pilot research (figure 14) it is already shown that the SFs for the MaaS pilot is not just the linear result of the governance factors (GFs), but the result of the interplay between the stakeholders, the interactions in the system and the actual travel behavior of the travelers. Therefore, it is not only important to determine the impact of the GFs on the ecosystem as independent variables, but also to track back from the SFs into the MaaS Ecosystem to try to understand how the pilot success was caused. This is important for creating a better comprehension of how the ecosystem works and aggregate knowledge about the pilot ecosystem as a basis for further learning.

Two of the SFs describe success in a more general way as success applying to all pilots and two SFs are more specifically applicable to the stakeholders. The two general SFs for the pilots are:

- Number of Users & Transactions
- Scalability

Number of Users & Transactions

The purpose of the transaction ecosystem is matchmaking where the value creation can be measured by the number of successful transactions and benefits to both sides of the market (Pidun et al., 2019). The number of transactions is a primary indicator for the pilot of how successful the pilot is. This is valid for all stakeholders. A high number of transactions just proves that the MaaS product proposal is regarded as valuable to the travelers leading to a high number of transactions. The high number of transactions will satisfy the MSP as their business model is built around the number of transactions and they are paid per transaction. For the Transport Operators (TO) it is better to have a high number of transactions than a low number. However, it could be the case that the high number of transactions does not apply to all TOs, and one or more TOs might be excluded from high numbers. For example, if a TO offering e-scooters is not used frequently by travelers and little transactions take place for just this part of the MaaS offering, it will not experience the pilot as a success and it will have to investigate what the root cause is. It could be as simple as a tariff that is too high, or it could be that the average age of the travelers is very high, and they do not favor transport by e-scooter. Further investigations of the results will make this clear. The number of users is also a good generic indicator of how well the pilot is running as it can be stated that the more users, the more successful the pilot. It means that a bigger group in society is reached and is using MaaS and the objective of MaaS is that it will be a common way of thinking about mobility in society. Also, it is important to investigate who the users are. Based on that analysis conclusions may be drawn about how successful MaaS is for the specific stakeholders.

Scalability

Scalability is also a generic indicator of success for the participants of the pilots as it is one of the major objectives of the MaaS pilots. The learning resulting from the pilots will give information on what factors are important for scaling up MaaS. Ultimately to a national level. Scaling up and scalability have been one of the major reasons for participants to enter the pilots. This has been confirmed by several of the interviewees.

The two success factors that apply specifically to the stakeholders of the MaaS pilots are:

- Stakeholder satisfaction

- Knowledge

Stakeholder satisfaction

Pilot success for the stakeholder is of course defined by its specific objectives that vary per stakeholder. The local government as a stakeholder will focus on different things for success compared to a TO. Where the local government strives to have fewer cars in the center and regards that as a success, the TO of e-bikes is focusing on the frequency its e-bikes are being used to measure success. Each Stakeholder will have its own specific and primary targets of success.

Nevertheless, not just the targets of the stakeholder itself must be evaluated, it is key for the success of the MaaS ecosystem, that also joint success is evaluated. All stakeholders are working inside an ecosystem and for individual stakeholders to remain successful it is also critical that the ecosystem will be successful. If the MaaS ecosystem as a system fails, it will directly damage its individual stakeholders. A coral reef is a good analogy of an ecosystem in balance. Once the coral starts to degrade, other 'participants' of the coral reef will suffer from that with the risk of losing the ecosystem in the end. So, integrating a success measurement, measuring the health of the ecosystem will ultimately benefit the individual stakeholder as well.

Knowledge

Building knowledge is one of the main objectives of a pilot. What can be learned from the pilot, can be used for further extension of the concept of MaaS and MaaS ecosystem. Each stakeholder will have its specific knowledge area: For the MSP it will be different than for the TO. It goes beyond the scope of this study to further detail this. However just as with the stakeholder satisfaction measurement for success, also this SF should not only be studied at the level of the stakeholder but also at the level of the ecosystem. As the health of the ecosystem is of importance to all the individual stakeholders. A potential way of incorporating the ecosystem in the success measurements might be to appoint the ecosystem itself as a stakeholder and assure in the coordination and communication GF that the interests of the ecosystem are considered as that of an individual participant or stakeholder to the MaaS ecosystem.

6. Discussion

6.1 Theoretical Contribution

In reaction to several societal challenges concerning mobility like congestion, sustainability, clean air in cities, accessibility, more efficient use of resources, etc. in combination with technological developments in digitization, Mobility as a Service saw life for the first time on a commercial scale in Helsinki, Finland some three to four years ago. The identified challenges in Helsinki are like the challenges in cities in the Netherlands. However, outside the cities, The Netherlands is quite different from Finland, posing its own challenges relevant to the Dutch mobility context.

Giving the very limited empirical studies on MaaS or its governance (Hirschhorn et al., 2019) and the very limited knowledge of MaaS in the Netherlands (Durand et al., 2018), this study adds to the literature by investigating seven Dutch MaaS pilot projects adding to the empirical MaaS knowledge base in general and in the Dutch context. The focus of this study is on the Governance factors involved and their impact on the success of the pilots. The MaaS pilots researched are in their initial stages of the implementation process, justifying the main focus of this study on these initial stages. As the Corona pandemic developed during this research, the impact of Corona on the MaaS ecosystem and its stakeholders, the governance factors, and the success factors were taken into account in this study.

As the concept of MaaS is relatively new and gaining wider acceptance, there are misconceptions about what the MaaS is and what the MaaS ecosystem is. Kamargianni and Matyas (2017) were the first to create a clear definition for the MaaS concept and to define it as a business ecosystem. Even though the term "ecosystem" is used more and more, it is often based on unclear definitions and with a scope too broad to apply effectively. (Pidun et al., 2019, p.1). This study provides (further) justification to use the business ecosystem as a governance model. By applying the model of Pidun et al. (2019) it is clearly shown that the concept of MaaS fits the characteristics of the transaction ecosystem as a governance model. This research confirms and strengthens the view that MaaS functions as an ecosystem and that for the success of implementation, the paradigm of an ecosystem is important for all stakeholders to embrace and consider in their way of operating. This study also adds to Kamargianni and Matyas (2017) by developing additional appropriate enabling frameworks that are applied in the seven Dutch MaaS pilots. For example, appointing an ecosystems director illustrates this.

Both Kamargianni and Matyas (2017,p.13) and Vonk Noordegraaf et al. (2020) mention that the role of governance (regulators) is of vital importance in the early stages of the development of the MaaS ecosystem. The results of this study confirm the importance of the role of regulators (government), creating the right conditions for the MaaS ecosystem. The study elaborates on this for the specific Dutch pilot projects and highlights specific contributions adding to the MaaS knowledge base in general and the Dutch MaaS context specifically. For example, demanding that long-term public transport contracts must be made fit for MaaS, assuring interoperability illustrates this.

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Traditional governance tools such as blueprint approaches, programs of demands, and linear implementation models with little or no change during implementations are not effective in an innovative and developing environment like the MaaS ecosystem. In the traditional setting, rules and regulations follow the societal developments and they are adapted once a negative impact is the result. So reactive and after the fact. This is illustrated by the developments of Airbnb and UberPop. Airbnb became very popular in Amsterdam. It grew quickly to a scale where nuisance for the local inhabitants became so big that based on their protests the city council restricted the number of days per year a house could be rented to a service like Airbnb. With UberPop, an alternative for car transportation on demand, something similar happened as UberPop competed with local taxi companies. Kamargianni and Matyas (2017, p.11) state that "Regulators and policymakers … are key actors that could enable the MaaS market". To enable an ecosystem driven by innovations and integrating multiple transport modes with many different stakeholders the use of the governance will be different. A balance between regulation and standardization for the proper functioning of MaaS on the one hand, and innovation and development need on the other hand need to be found and managed. The role and the role view of the function of the contract manager (on either local, regional, or national level) is important for the successful implementation of MaaS. The creation of the role/function of ecosystems manager overlooking the ecosystem will secure a more integrative view required for the ecosystems approach.

This study further elaborates on the role of the ecosystem's manager (or better director) as an enabler of the ecosystem. The MaaS ecosystem carries a lot of complexity with many different stakeholders acting at different levels, with different strategies, and acting under different circumstances. One of the biggest challenges in the ecosystem is the alignment of all this to create a properly functioning system. This means that the activity of synchronizing all these processes leading to enhanced alignment is a major task to be performed in the ecosystem. This seems like a great task for the ecosystem's manager.

6.2 Limitations

During this research, there was one very unexpected limitation, namely the corona pandemic. Without Covid-19, The MaaS pilots would have started and have been running live for about six months at the time of writing. The results of these first months would have produced initial data regarding the impact of governance on the success of the MaaS in operation. These results would include data of the users (the travelers) as well as the active engagement between the stakeholders of the pilot. A further optimized learning process and the stakeholder's findings regarding (realized) success. As a result, the scope of the research had to be adjusted. As mentioned in the analysis, the pandemic also results in changing the behavior of both the stakeholders and end-consumers which might result in different results when reproducing this research. The research does however allow for reproduction with the use of the interview guide and questions which can be found in the appendix (A, B) creating external validity.

As the interviews were conducted in Dutch, interpretation from the researcher when using quotes might leave out certain nuances. Also, some of the information provided during the interviews were considered privileged information and could therefore not be included in the research. Furthermore, there could be a bias of the researcher when interpreting the empirical data in the coding process and further analysis.

There may be selection bias as the interviewed stakeholders might portray a biased view because of interests that are at stake. During the research 81% of the targeted stakeholders were interviewed, a limitation of the selected stakeholders though, is that one stakeholder group namely the Transport Operators (TO) were not directly included (even though some MSP's can be considered TO's). This is mainly because in the pilot set up the communication with and towards TO's is allotted to the MSP. Including this stakeholder group may provide contrasting views and new insights.

6.3 Further Research

As not all aspects of MaaS (ecosystem) and the seven pilots could be captured within the scope of this research, there are areas for which further research is advised. One key focus for further research is the end-consumer and his behavior in the adoption and usage of MaaS. Gaining more insights into end-consumer behavior is of great importance for an increased value of the ecosystem and policy implementation.
Transport Operators (TO's) are also identified as an area where more research is advised. TO's form the basis on which the MaaS ecosystem can grow, their role should not be underestimated as part of the value is the access to different modalities.
In section 5.4.2, a schematic relationship between the GFs has been created. For more insight and understanding with regards to the interaction between those factors, further research is recommended. Further research is also advised on possible confounding variables that influence governance, the ecosystem, and success.

Lastly, further research is advised on how to effectively make the ecosystem paradigm an integral part of the mindset of all stakeholders in the MaaS ecosystem as this will promote and increase the likelihood of success of the MaaS ecosystem.

7. Conclusions & Implications

This study researched *whether and how governance factors determine the success of the MaaS pilots' implementation in the Dutch mobility system*. The lack of empirical data concerning MaaS in general and the Dutch mobility system specifically were the reasons to start the seven MaaS pilot projects in The Netherlands. Especially in the early stages of the development of MaaS, it was identified that government (and thereby governance factors) play a key role. Governance factors like spatial planning, public transport, laws, rules, and regulation are managed, controlled, and financed by the government. The involvement of the (Dutch) government is thus crucial for the successful initiation and deployment of MaaS in The Netherlands.

This study researched how the governance factors of policy, resources, standard setting, data sharing, and coordination would drive MaaS to success, measured in the pilot success factors of scalability, knowledge, stakeholder satisfaction and number of users and transactions. The study was realized by conducting semi-structured interviews with the identified stakeholders in the seven MaaS pilots. 81% of these stakeholders were interviewed and these interviews were analyzed by using in vivo coding. Due to Corona, the actual starting dates of the pilots have been considerably delayed, so none or hardly any pilot data was available for this study. Corona was added in the revised conceptual model as a confounding variable.

To investigate the influence of governance factors on MaaS, first, an evaluation was made to choose a governance model that would best fit the development of MaaS. Based on the characteristics of MaaS, it was concluded that the *transaction business ecosystem* matched, based on high modularity, high need for coordination, high level of customization, and the occurrence of multilateralism (Pidun et al., 2019). Using the transaction business ecosystem by the stakeholders as a paradigm can be helpful for the successful implementation of MaaS, because it makes all stakeholders aware of their interdependency and that a well-functioning ecosystem will also support the individual success of stakeholders. A well-functioning MaaS ecosystem with a sufficient supply of mobility opportunities will attract more travelers, increasing the number of transactions, hence improving the business case for mobility and MaaS providers for example.

The relationship between government factors and pilot success was not linear, but much more complex as MaaS involves a multitude of players in dynamic interaction and a diverse environment: an ecosystem. The governance factors impact the ecosystem, the ecosystem absorbs this impact and through the dynamics of the ecosystem, the pilot success factors can be measured and analyzed. Based on the learnings of this, government factors can be adapted to impact the ecosystem for better results. After some time the impact has to be measured and evaluated again. This iterative process will provide learning and build-up of knowledge about the MaaS ecosystem and how to make it (more) successful.

The Netherlands already has a strong public transport system, covering longer-distance trajectories. The objective of MaaS is to provide door-to-door mobility solutions, similar to a private car. In urban areas, the first and the last mile is increasingly well covered by micro-mobility solutions (for instance bike, e-bike, e-scooter, bike, e-kickboard). In smaller cities and rural areas, micro-mobility needs further development to cover the last mile from the public transport network to the final destination.

Over the different development phases of MaaS, different government factors play either a more, or less important role. In the early stages of MaaS development (construction phase and later maintenance phase), policymaking (defining the goals/desired outcomes), standard setting, and data sharing are very important. Coordination & Communication become more prominent in the execution phase of running the ecosystem using the tools of resources, laws/regulations/rules/contracts, and enforcement. The latter two were not part of the scope of this study. It is particularly important to pay specific attention to each governance factor and the interplay between those factors. In the pilots, the role of the contract manager and the steering team is critical in the aligning process both in the construction and maintenance phase of the MaaS ecosystem as well as in the running phase of the system. The role of governance remains important over the lifetime of the ecosystem.

The pilot approach is a good way to learn and to build knowledge about what works and what does not in a complex and dynamic system where also continuous innovation takes place. In the construction phase of the pilots, knowledge is mainly built and exchanged by people having meetings of which minutes are made and sent to the participants of the meetings as well as to members of the other pilots. This 'unstructured' knowledge is not taken up in the formal learning environment which is created to collect and analyze data from the pilots once they are running. Making this knowledge accessible by assembling the main take-aways of this part of the process in a structured (evaluation) report is advisable for future application and to prevent loss of important knowledge because of inaccessibility to it.

MaaS is a transaction ecosystem. Creating consciousness of the ecosystem paradigm to all stakeholders will make them aware of the fact that the success of the ecosystem is the result of the aligned objectives and that following the rules set out for the well-functioning of the MaaS ecosystem is in the best interest of all participants. The creation of the role of ecosystem manager, responsible for the wellbeing of the MaaS ecosystem by synchronizing participants' objectives whilst keeping sight of a sound balance between innovation and development on the one hand and standardization and tight regulation, on the other hand, is recommended.

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10. Appendix A --- Interview Guide

Introductie	Beste Deelnemer, bedankt voor uw bereidheid om deel te nemen aan dit onderzoek. Dit onderzoek wordt uitgevoerd voor een Master thesis van de Utrechtse Universiteit en gaat over de invloed van sturing op het succes van de MaaS pilots. Het interview zal ongeveer 45-60 minuten duren. Lees alstublieft de interview guide verder om een beter beeld te krijgen het onderzoek. Ik wil u er alvast op wijzen dat uw antwoorden anoniem zijn en **niet** met uw naam publiekelijk gedeeld zullen worden. Wij vragen onderaan de interview guide uw toestemming om de data vertrouwelijk te mogen gebruiken voor dit onderzoek.
Doel van het onderzoek	Het doel van dit kwalitatieve onderzoek is om inzicht te krijgen hoe governance/sturings factoren het succes van de Pilots beïnvloeden. Door dit interview te doen hopen we waardevolle informatie te verkrijgen betreffende het perspectief op aspecten van governance zoals: De coördinatie van de pilot, toegang tot middelen en informatie, huidige en toekomstig beleid en de standaarden/doelen die gesteld worden. Dit zijn een aantal variabelen die kunnen resulteren in een positieve invloed bij het uitrollen van MaaS in de pilot maar ook voor grotere schaal. Wij hechten veel waarde aan de input die u geeft tijdens dit interview en zijn benieuwd naar uw perspectief.
Onderwerpen	MaaS, governance, publieke/private samenwerking, leer processen, beleid, succes
Anonimiteit en vertrouwelijkheid	Zoals genoemd, zal de informatie die u verstrekt met uiterste zorg verwerkt worden. Hierbij wordt uw respons niet voor andere doeleinden gebruikt dan voor dit onderzoek. U blijft anoniem en het interview wordt als vertrouwelijk document behandeld. Als u hier meer vragen over heeft kunt u die uiteraard stellen (contact onderaan).
Vroegtijdig stoppen	Het is ten alle tijden toegestaan om het interview te stoppen tijdens of alvorens het begin. Hiervoor hoeft u geen reden te geven. Mocht u al informatie hebben verstrek zal deze niet gebruikt worden tenzij u ander aangeeft.
Opname	Gaat u akkoord met het opnemen van dit interview? JA/NEE
Vetrouwelijkheids overeenkomst	Ik, ________________________ ga akkoord met de deelname aan dit onderzoek en sta toe dat mijn antwoorden anoniem en in overeenstemming met de beschreven vertrouwelijk worden gebruikt voor dit onderzoek. ________________________ Handtekening - Datum: ______________________
Informatie	Wilt u op de hoogte gehouden worden van de resultaten van dit onderzoek? JA/NEE

Contact en informatie
Mocht u enige vragen hebben of additionele informatie verlangen dan kunt u contact openemen via telefoon of email: s.a.i.strikkers@students.uu.nl ; +31 6 39485539

11. Appendix B --- Interview Questions

Introducerende vragen	Hoe zou u dit bedrijf beschrijven?
	Wat is uw functie binnen het bedrijf?
	Wat houdt volgens u het concept van MaaS in?
	Welke rol speelt u (bedrijf) in het ecosysteem van MaaS?
	Wat is de focus van deze pilot
	Wat is de invloed van corona op deze pilot - Hoe gaan jullie hier in de pilot/als bedrijf mee om?
Governance factors	
Middelen	Tot welke middelen heeft u toegang door aan de MaaS pilot mee te doen? i.e. Financiële middelen/infrastructuur/informatie - Zijn deze middelen in voldoende mate aanwezig? Tot welke middelen zou u graag toegang willen hebben? Kunt u gemakkelijk informatie verkrijgen over het verloop en de ontwikkelingen in de MaaS pilot?
Beleid	Met welk beleid moet uw bedrijf/de pilot rekening houden? - Hoe beïnvloed dit uw bedrijf/vervoersaanbieders? - Kunt u positief beleid noemen en beleid dat mogelijk de pilot niet bevorderd - Heeft u suggesties voor (nieuw) beleid?
Standard Setting	Is het duidelijk welke standaarden behaald moeten worden? Kunt u een standaard noemen die bepaald is? Vind u de standaard(en) moeilijk te bereiken? Wordt er genoeg gemotiveerd deze standaard te hanteren? Standaarden die nodig zijn om MaaS makkelijker te maken, bepaalde regelgeving
Data delen	Welke data wordt gedeeld binnen de pilot? Wat vind u van de conditie dat de meeste data gedeeld moet worden? Heeft u het gevoel dat u iets terug krijgt voor het delen van de data? - Is dit voldoende? Wat zou u er voor terug willen hebben?

	Is het duidelijk welke data gedeeld wordt en ervaart u knelpunten in het delen van data?
Coördinatie (en communicatie)	Op welke manieren ervaart u coördinatie binnen de pilot? Op regionaal en op nationaal niveau Wat ziet u graag anders in het coördinatie proces? Is het duidelijk wat jullie bedrijf moet doen om de pilot succesvol te maken?
Pilot Success	
Insights/ knowledge	Hoe worden verworven kennis/ontwikkelingen opgeslagen en gedeeld? Hoe draagt dit bedrijf/u bij aan het leerproces van MaaS? Wordt er vaak geëvalueerd over de ontwikkelingen? - Is er (gemakkelijkt) toegang tot deze verkregen inzichten?
Hoeveelheid transacties	Wat is de doelstelling qua gebruikers aantallen binnen deze pilot? Kunt u een schatting doen van het aantal transacties dat door MaaS wordt gegeneerd naar de klant? Zijn er veel transacties tussen de verschillende deelnemers in de pilot? Denk u dat de pilot het aantal transacties van uw bedrijf verhoogd?
Scalability	Is deze pilot geschikt voor opschaling? Wat zijn de limitaties voor opschaling? Hoe denkt u dat deze limitaties overkomen kunnen worden?
Deelnemer tevredenheid	Voldoet de pilot aan de verwachtingen? - Waarom wel/niet? Motiveert deze pilot dit bedrijf om door te gaan met dezelfde deelnemers? - Waarom wel/niet? Waar bent u ontevreden over? Waar bent u tevreden over?
Participation	Voelt u zich erg betrokken bij deze pilot? - Op welke manier? Hoe zou het bedrijf/bedrijven meer betrokken kunnen worden bij de pilot? Zorgt deze pilot voor motivatie om door de gaan op een vergelijkbare manier? Wat zou uw motivatie kunnen vergroten voor MaaS/de pilot?

12. Appendix C --- Coding process in 'NVIVO'

Algemeen	0	0
Concurentie	8	15
Commercial interest	3	5
Deelnemers	4	5
'actieve gebruikers'	9	15
Definitie	3	3
Doelstellingen	9	23
Mijlpalen	2	4
Drivers and Barriers	2	4
Barriers	5	8
Limitations	3	9
Weerstand	2	3
Drivers	2	2
Voordelen MaaS	3	3
Ecosystem	8	17
Deel mobiliteit	10	24
Deelvervoerders TO's	9	20
Externe Partijen	2	3
Level playing field	3	4

Overige	0	0
Controversy	1	1
Focus per pilot	2	2
Amsterdam	2	5
Eindhoven	2	11
Groningen Drenth	1	2
Limburg	2	5
Rotterdam	3	9
Twente	1	4
Utrecht	3	8
I&W	6	16
Kritiek	1	1
Politiek	1	1
Incentives	2	6
MDV	4	11
Tenders	1	1
Transactions	1	1
wmo	4	11
P&R	1	1

Governance	3	4
Coordination and commu	6	13
Communicatie	3	3
Consortium	3	3
Contractmanager	7	15
Coordinatie	6	11
Decision making	2	2
Evaluatie	2	2
Gemeente	7	17
Het proces	6	9
Management	2	2
Meetings	4	11
Processen	3	7
Projectleiders	4	7
Stuurgroep	5	6
Data Sharing	10	23
Data	13	37
Privacy	8	18
TOMP API	13	47

Policy	6	6
Duurzaamheid	5	6
Gedragsverandering	3	4
innovatie	3	3
International	1	1
Local	2	2
Nadere overeenkoms	6	7
National	1	1
policy	10	22
Programma van Eisen	4	5
Raamovereenkomst (	10	15
Ruimtelijke ordening	8	9
Vergunning&concessi	12	23
Resources	1	1
Financial	3	4
Financiering	11	24
Fysical resources	1	1
Information	2	3
infrastructuur	4	4
Middelen	5	6
Subsidie	3	5

Standard Setting	3	9
Barriers	1	1
Standaarden	12	28
TOMP API	13	47
Success	8	11
Knowledge	3	7
Kennis verwerving	12	33
Leeromgeving	7	16
Own data collection	6	7
TNO	3	4
Motivatie	4	4
Persoonlijk	12	22
Participation	2	2
samenwerking	1	2
Verwachting	4	5
Scalability	1	2
Internationaal	4	7
Schaalbaarheid	12	19
Limitaties	7	8
Stakeholder Satisfaction	1	1
Persoonlijk	12	22

13. Appendix D --- Coding process in 'NVIVO'

Name Interviewee	Code	References
1	34	63
2	37	76
3	40	99
4	33	68
5	44	85
6	37	62
7	29	60
8	35	66
9	39	78
10	32	63
11	34	65
12	40	76
13	31	48
14	35	69

Codes and references per interviewee (names blurred for privacy concerns)