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The Role of Public Administration in Supporting Electric Vehicles within Mobility-as-a-Service Model

Master Thesis

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Background, Motivation and the Main Idea of the Thesis

Mobility-as-a-Service (MaaS) is seen as a tool to make the personnel traffic system more efficient in urban areas. The public administration of Finland, on the government as well as on the city level, has taken successful steps towards the implementation of MaaS.

On the other hand, electric vehicles (EV) have the potential to improve the liveability of the urban areas but have not taken off as commonly expected few years ago. The main reasons are their relatively high price, the lack of public or semi-public charging infrastructure, low range and the doubts of the customers towards new technologies.

MaaS-model provides means for supporting the adaptation of electric vehicles in an urban environment, and, at the same time, create new markets in the form of digital services to the car industry. Additionally, MaaS has a great potential to decrease the total number of cars and to increase the use of public transport.

Public administration has a key role in enabling MaaS models. The implementation of MaaS requires political willingness and the ability to bond different actors (private and public companies, public administration and end customers) together. Finland is one of the global leaders in the adoption of digital services and has paved the way to implement a successful MaaS model that provides valuable lessons-to-learn to Germany.

The thesis will study the means how the Finnish public administration has obtained to tie different actors together, forming a successful ecosystem for MaaS. Best practices are taken from Finland and seen how they could be adapted to Germany. Since the automotive industry is highly important for the German economy, the support of MaaS for electric vehicles will have a special focus in this thesis.

Due to the critical role of the automotive industry in the German economy and in the politics, it is unfeasible to create conflicts of interest between the automotive industry and the other actors. This is why the main idea of this thesis is to find a way to improve the German personnel mobility system as a whole so that it takes the benefits of the automotive industry into account, creating new unexplored market possibilities.

Tentative Work Plan

The main object of this thesis is to create a roadmap or a guide for German administration (or any party of interest) in order to support electric vehicles through MaaS. Firstly, the receipt of success for MaaS in studied. Secondly, the focus is put on electric vehicles in the MaaS-concept. Finally, the roadmap for German authorities is formed. The main parts of the work are organized as follows:

1. The receipt of success for MaaS in Finland:

   - Which are the most important actors involved in a successful MaaS concept?
   - What public administration (city-level / government-level) could do in order to support the MaaS model? Which are the most efficient methods?

2. Electric vehicles in MaaS model:

   - Which actors are necessary to enable an efficient EV-MaaS (the part of EVs in MaaS)?
   - What public administration (city-level / government-level) could do in order to support the EV-MaaS?
   - What are the benefits for EV business of MaaS model compared with only EV sharing (without being a part of MaaS)?

3. Roadmap for German authorities

   - What German authorities (government-level / city-level) should do in order to support the business of EVs through MaaS model?

The thesis is carried out partly in Dortmund and partly in Tampere. The work consists of expert interviews as well as the literature review. People participating in the interview come from the industry and from the public administration.

Abstract

The impact of mobility has increased in the past years heavily. It is not just important to reach every day goals, whether professional or private, it is also reflecting the demand of recreational activities, traveling and tourism. Nevertheless mobility is facing great challenges but also opportunities. On the one site trends as urbanization and individuality making it difficult to reach climate targets. On the other site mobility doesn't respond to the current possibilities of digitalization. Mobility-as-a-Service is one upcoming mobility system, which uses the possibilities of digitalization, decreases individual traffic and even increases the convenience of the people. The core element of Mobility-as-a-Service is to change the focus of mobility from a good to a user orientated system, which priority it is to reflect the needs of the people. Furthermore e-mobility can not just be supported by Mobility-as-a-Service for further developments, it can even be seen as a symbiosis, where both technologies encourage the development of each other. The thesis examines the high importance of public administration within the implementation process of Mobility-as-a-Service and e-mobility in Germany and gives an implementation guideline to the German authorities.

Acknowledgment

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Alex Rotgang

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Abbreviations

MaaS   Mobility-as-a-Service

E-Mobility   Electric Mobility

E-Vehicle   Electric Vehicle

E-Ticket   Electronic Ticket

GDPR   General Data Protection Regulation

CsgG   German car sharing law

PBefG   Passenger Transportation Law (Personenbeförderungsgesetz)

D2D   Door-to-Door

API   Application Programming Interface

BMWi   Federal Ministry of Economics and Energy

BMBF   Federal Ministry of Education and Research

BMUB   Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

BMVI   Federal Ministry of Transport and Digital Infrastructure

RDI   Research, Development and Innovation

IHK   Chamber of Industry and Commerce

1 Introduction

Mobility has a more and more increased impact on everyday life. It is not just important to reach everyday goals, whether professional or private. There is a larger focus on an increased demand for recreational activities, travelling and tourism, which makes mobility to a key factor of the future. Furthermore, the world is confronted with new opportunities and challenges that are affected by trends of the future. One of these mega trends is digitalization. Digitalization is the transformation and implementation of communication and information or digital modification of instruments. It can lead to improvement of efficiency and flexibility in a whole sector [1]. Another mega trend is urbanization. Urbanization describes the propagation and diffusion of urban life and behaviors. In this case, urbanization describes the land-city migration of the human population [2]. Furthermore, the mega trend of individualization, in this context, can be explained as the desire of every person for flexibility and independence to coordinate daily necessities, social contacts, and the evolving work environment. All previously mentioned trends have a huge impact on the mega trend "climate change". The United Nations already held their first climate conference in 1995, where a special task force was elected to elaborate goals to reduce emissions and the output of greenhouse gas. In the context of reaching this goal, the subject of mobility is in between of renewable energies, energy efficiency, infrastructure and agriculture one of the political main actions of the German government [3].

Furthermore, the president of the German federal bureau for Environment displays the necessity of a change in the German mobility sector, so that the defined climate goals may be reached [4].

Transport is the biggest problem in climate protection. Therefore, we cannot leave the car industry out of responsibility. After all, road traffic still accounts for the majority of emissions.

Svenja Schulze Federal minister of environment [5]

To figure out how the output of greenhouse gasses can be reduced, a closer look at the current mobility concept is necessary. In the current mobility concept, each

mobility service subsists side by side. This means that each person can choose between driving by car, using public transportation, riding a bicycle or walking to fulfill their individual needs.
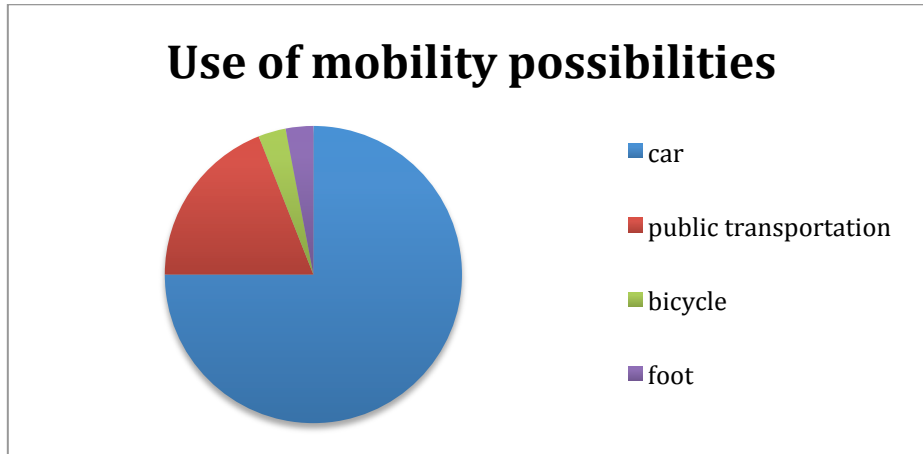
Figure 1 – Usage of mobility options

The above pie chart (Figure 1) shows the wealth and wish for flexibility and comfort. More than 75 % of all kilometers travelled are done so by car. Just 19 % of each kilometer is covered by public transportation and just 6 % by bicycle or on foot. In addition, more than 78 % of private households own at least one car, and approx. 25 % own even two or more cars. By itself, this presents no problem. However, private cars are only used by 1.5 passengers in average. In addition to this, cars are only used in 5% of the day [6]. This development shows an inefficiency of using resources and increases the amount of greenhouse gases.
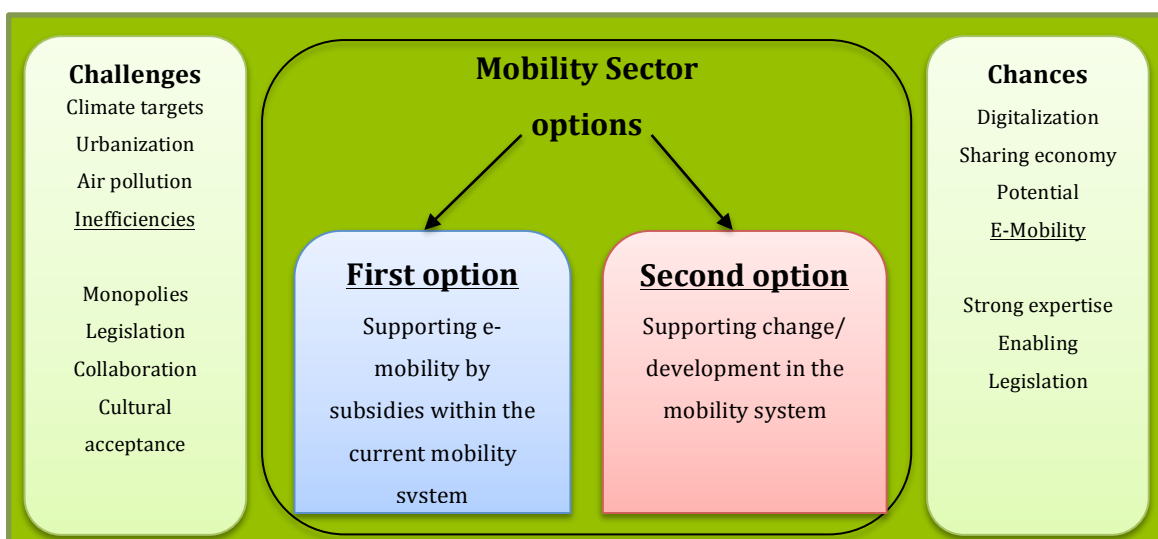
Figure 2 – Opportunities and Challenges of the mobility sector

Marius Schädel shows, in his work, what options are available (see figure 2). The figure below summarizes these possibilities and shows what kind of challenges and opportunities the mobility sector faces [7].

On the one hand, it is possible to keep the current mobility concept and support the utilization of e-mobility. In this case, political subsidizations or investments are needed to make e-vehicles in particular affordable and to support the expansion of infrastructure for e-mobility. On the other hand, it is possible to implement a completely new mobility concept. This concept could support the previously mentioned trends of digitalization, urbanization and individualization. It could help reach the climate goals and optimize the usage of mobility options. Currently, scientific research is handling a number of concepts that could be implemented to the German straits. The most promising one, which is already implemented in Europe, is the concept of Mobility-as-a-Service (MaaS) [8].

MaaS first received attention after Sonja Heikkilä published her master thesis in 2014. This thesis deals with an action plan for the public administration to implement MaaS [9]. Especially in Finland, the MaaS concept earned a lot of attention during the past few years. In the beginning, researchers tried making basic definitions, where Jittrapirom et. al. discussed critically different definitions [10]. Nevertheless, MaaS is not the only new approach for an adequate way to tackle the previously mentioned challenges [11].

One of the first papers about a German MaaS concept was Taneli Vaskelainen´s dissertation, "*The Emergence of the Sharing Economy Industry – Insights from the German Carsharing Industry*", published in August 2018. Vaskelainen hypothesizes that car sharing providers will have a key role in a German Maas system [12]. Building on that, Marius Schädel was the first who combined all players within the mobility sector to a multimodal network, wherein all would coexist in collaboration. It mainly concentrates on the feasibility of MaaS in Germany and the role of E-Mobility within it [13]. The following thesis will build on this work, elaborating the role of public administration inside of a MaaS-concept for Germany.

Existing publications only deal with the role of public administration in a specific sector, such as the work of Nihan Akyelken et al., *"The importance of institutions and*

policy settings for car sharing – Evidence from the UK, Israel, Sweden and Finland", where the role of governance and policy settings in-between a car sharing concept was analyzed. Their work figured out which roles the government and their policies play in implementing a car-sharing system [14].

The necessity of a new mobility concept in Germany is attracting attention in society and politics.

Germany needs a change in mobility, this is clear. We will have a fast implementation of E-Mobility, now.

German Chancellor Angela Merkel [15]

This quote shows that the government is already trying to implement e-mobility and knows about its advantages. The essential problem is understanding which model fits best to implement it. In this case, mobility as a service could be a solution. First, there is already mentioned urbanization of cities to consider. The problem is that adding new roads or transit is inefficient or not possible. For instance, one might look at New York's legendary road builder, Robert Moses, who was confronted with a strongly growing number of citizens during the beginning of the 20th century [8].

In addition, MaaS also matches the other mega trends in current society. Digitalisation is one of the core elements within it and approaches an individual service for each customer. Further information will be discussed in Chapter 2.

The lack of information about implementation of MaaS and the role of administration within it causes an explorative research design. Therefore, experts from Finland shall help to provide insights. MaaS has already been part of the mobility concept in Finland since 2016 [8]. The knowledge of Finnish experts and legislators will help to understand how the concept of MaaS has been implemented and what role the public administration took during this time. This new knowledge basis shall help elaborate a roadmap for the German government to implement MaaS in Germany.

Before analyzing the Finnish mobility concept, the first part of this thesis will be a short introduction of the MaaS concept, where main players and the idea behind this system will be explained. Additionally, the requirements for the implementation of

MaaS will be shown and in particular the possibility to implement MaaS in Germany. Afterwards, the role of electric vehicles within MaaS will be displayed, so the importance of this coexistence can be shown. Chapter four describes the methodology used to collect and analyze data for this approach and explains the reason for this method. In Chapter five, the Finnish MaaS concept will be analyzed, main players within this concept identified. Furthermore, the role of public administration will be detected, and the action plan of the Finnish government used to implement MaaS as a new mobility concept. In the next Chapter, present German plans of the public administration for future mobility and the possibilities for a multimodal concept of mobility shall be identified. Based on these results, in Chapter seven, information from Chapter five and six will be used to design a roadmap for MaaS in Germany and showcase the importance of electric vehicles within this concept. In the end, a brief summary of the results and an inference will be given. In this outlook, questions that emerged during the writing of this thesis shall be highlighted, so future researchers can utilize them as reference points for their own analyses.
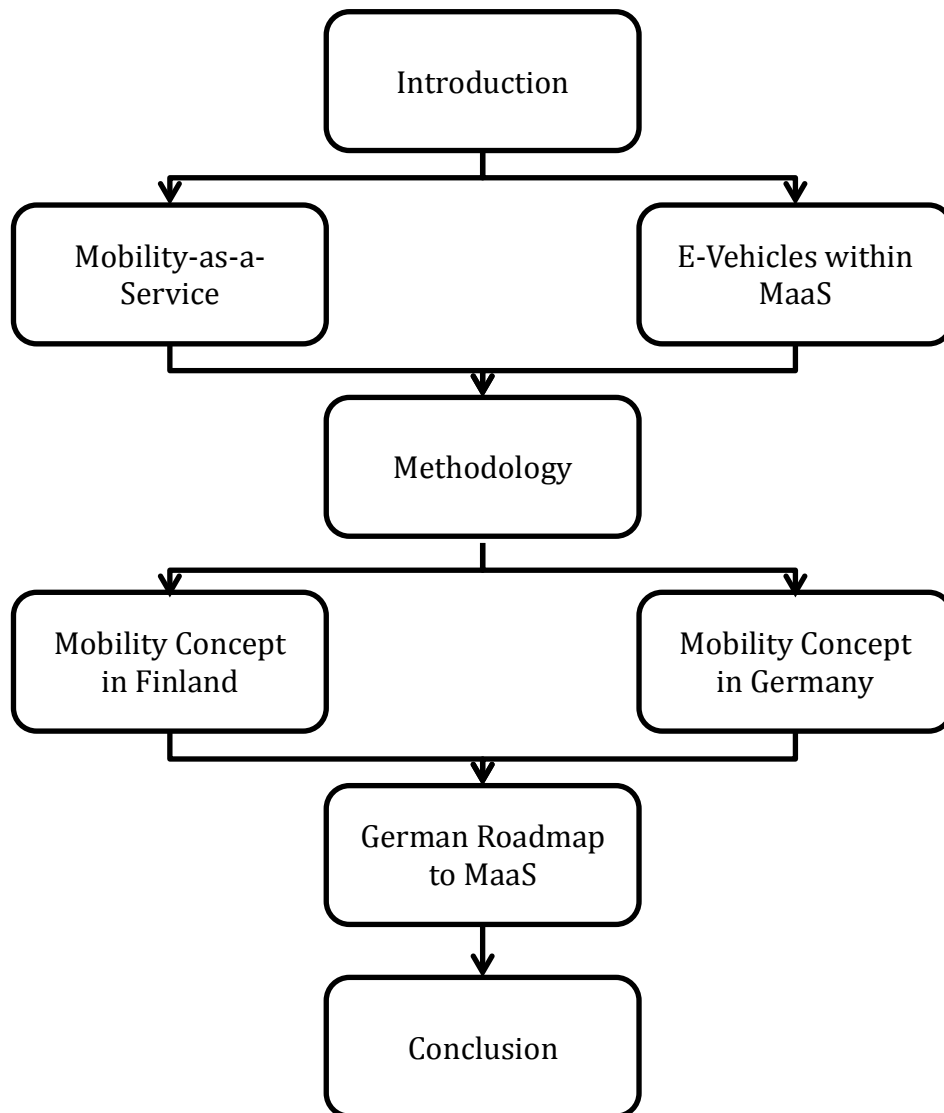
Figure 3 - thesis guideline

The delineated structure will help to answer the three main hypotheses of this paper:

1. Why is MaaS as a concept so successful in Finland?
2. Which role does e-mobility have within the MaaS concept?
3. How can the German government support e-mobility in combination with MaaS?

2   Mobility-as-a-Service

Mobility is an everyday need. Especially in high density and urban areas, many options are available, such as riding a bicycle or walking to visit neighbours, driving a car or using public transportation to get to work early in the morning. Alternatively, it is possible to choose between a train or an airplane to reach destinations that are far away. The current mobility concept provides all options separately, so every person can choose which is best. The fact that MaaS is part of the long-term transport policy of the Finnish government and the rising number of taken rides, which already exceed 1.5 million in the last year, shows the capability of this concept. This Chapter will explain, on the one hand, the differences between MaaS and the current system. On the other hand, the definition and the opportunities of this concept shall be delineated.

2.1   Definition

The current mobility system is already moving away from ownership [17] to a sharing ecosystem with mobility options like ridesharing [18], Uber [19] or bike sharing [20]. A further boost for the shift to a sharing economy will be self-driving technology, which shall be available for everyone by 2020 [21]. This development is the basis for MaaS and the reduction of privately owned cars.
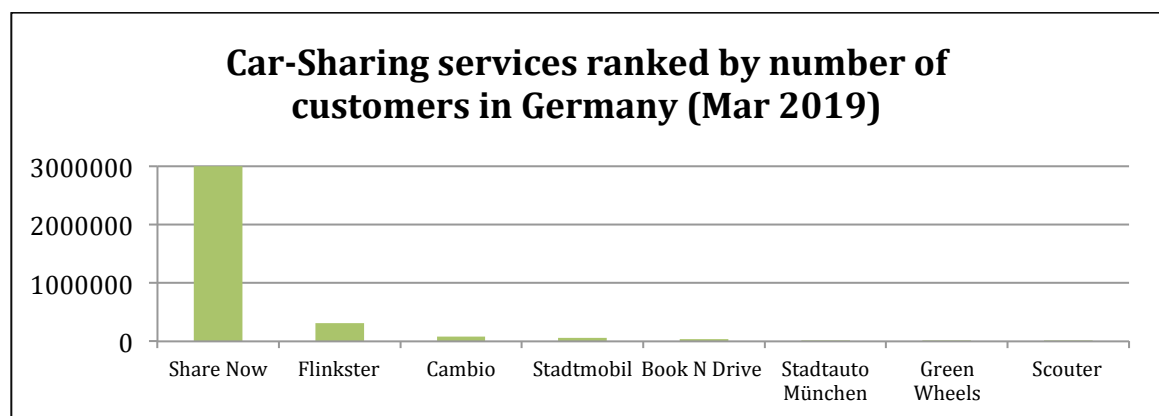
Figure 4 - Car-Sharing Services ranked by numbers of customers in Germany [22]

In the figure below, the basics of a MaaS-system is portrayed (Figure 5). A MaaS provider customizes an individual mobility plan for each person, who uses all

available resources without owning a car. For example, it is possible to use a stationed car close to one's home to take the bus that rides close to a determined parking area, and continue by train to one's destination. With this service, it is possible to use any combination of mobility opportunities to reach any destination in the fastest, easiest or cheapest way. It is a service that helps each person to travel from point A to B – i.e. a D2D-service. In this ecosystem, different kinds of players can participate. One of them is the customer who is using the service. Furthermore, there are the mobility providers who offer, for example, the cars or bikes meant to be shared. Moreover, there could be a separate platform provider who connects the user with the provider. In addition, as last participant, there are the service companies, who (for example) provide the connection (internet and smartphones).
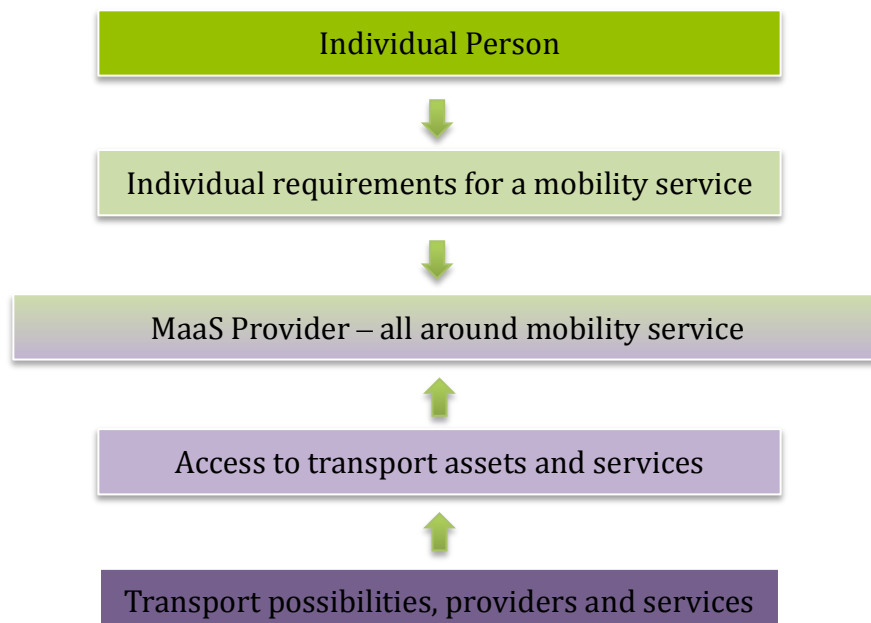
Figure 5 - Concept of MaaS

This service is an already used concept extant in, for example, the UK, Finland and Belgium through the application Whim [23]. Furthermore, it exists in Australia and New Zeeland [24], Germany [23]; [24], the United States of America [27], and Sweden [28].

All in all, MaaS provides five features that customers benefit from. First of all, MaaS gives every person a **personalised service**, wherein the provider learns from the customers' habits and builds a personal relationship between customer and service

provider. For this, a digital platform is needed, where the service provider, Whim for instance, can communicate face-to-face with the user and give them the best options for travelling. In addition, additional information like traffic or the latest news can be provided over this platform.

Next is the **ease of transaction**, i.e. customers can easily pay their service via their smartphone, smart watch or other devices.

Close to it is the **ease of payment**, where every customer can pay for a mobility plan that fits their necessities. To fulfil the needs of every customer, it is possible to choose between different tariff options. At the moment, Whim is providing three different options in Helsinki. The first one is totally free; customers can pay for every ride separately. This option could be useful for a person who lives close to their workplace and just sometimes needs a transportation opportunity for a longer distance. The second option provides a service wherein customers have limited access to different mobility providers, like the "City Bike" for only 30 minutes in one go. This package is, for example, suitable for a customer who often uses public transportation and sometimes needs fast rides with a taxi or a rental car. It allows the customer to pay less for the option's use. The last option is the unlimited package, which is also the most expensive. In this package, all rides are for free after the customer paid their monthly fee. This option is mostly for people who have to get to their destination very quickly on a daily basis.

	Whim To Go	Whim Urban	Whim Unlimited
Monthly payment	Free	49€	499€
Local public transport	Pay per ride	Unlimited Single Tickets	Unlimited Single Tickets
City Bike	Not included	Unlimited (30min)	Unlimited
Taxi (5km radius)	Pay per ride	10€ per ride	Unlimited
Car rental	Pay per ride	49€ per day	Unlimited
Car share	Coming soon	Coming soon	⊘
Cancel anytime	⊘	⊘	⊘
Add-ons incl regional HSL ›			

Figure 6 - Whim plan options in Helsinki

Additionally, a **dynamic transportation management** is available. This service gives a real-time update about the journey and updates if changes must be done. Therefore, an efficient use of the concept is required, where new technologies like smartphones with Internet connection, electronic ticketing, and a database management are needed to fulfil these requirements and must be as efficient as possible.

Lastly, the journey can be **adapted to the needs of each customer**, which gives the opportunity to choose, for instance, the cheapest, most comfortable or shortest way. It is important that MaaS support the use of public transportation, so the efficiency of mobility can be increased, but it also needs to be a real alternative to a privately-owned car. Therefore, it is possible to choose between a rental or a shared car, a shared bike, a taxi, trains and busses or even a ferry or an airplane. In addition, it is possible to book a combination of all these services to meet the needs of the user [29].

Summarized, MaaS can lead to the change that the current mobility system needs. In the introduction, it was mentioned that the current personal mobility concept is overwhelmed by the challenges of the time. Digitalization, urbanization, individualization, and climate-change-induced goals cannot be reached with the current mobility concept without massive subventions by the public administration. In this Chapter, it has been shown that MaaS can improve the current system by mastering the challenges of the times. The digital platform of MaaS, which aids individual needs and helps transport a high density of people in an efficient way, shows an opportunity to use the current possibilities and master the challenges. The number of people with a smartphone is increasing, which gives MaaS (as a digital platform) an easy access to its services. In addition, the possibility of digital paying via online banking and booking gives the customer an easy opportunity to use this platform. Furthermore, an efficient use of MaaS can be provided by data exchange and high and fast potential to analyse this data. However, the most important aspect for a successful MaaS concept is the rising sharing economy, like Figure 4 shows.

This development shows the possibilities MaaS has, by using the current trends, combining them into one concept and dealing with the challenges of the current era.

Even more important are the climate goals the public administration in Germany has set. For that, e-mobility must be encouraged. As previously mentioned: for the government, e-mobility is the future way of transportation. The only problem is building up an adequate infrastructure and increasing the density of e-mobility. Especially increasing the number of e-vehicles is a fundamental challenge (see Chapter 3) [31] [32].

2.2 Advantages and disadvantages (Aspects of implementing MaaS in Germany)

Before analysing e-mobility within MaaS, there must be a critical look at its advantages and disadvantages. In [13], Marius Schädel divides MaaS into four main criteria for a feasible concept. These criteria are technical condition, regulatory and political conditions, economic conditions, and infrastructural conditions.

The first category includes the technical conditions of an area where MaaS could be implemented in the future. It describes how well- or badly-integrated solutions, like applications or pilot projects, are already in use. Furthermore, studies have shown that a high usability for the costumers is necessary, such as is the case with car sharing [33]. Even more important is the coordination of a tariff system, which allows a paying model via one platform for heterogeneous mobility providers. Another important point for the technical conditions of an area is the distribution of smartphones. But the most important feature is the availability of the Internet, even in a countryside area, to ensure the functionality of the service [34].

The next category is about the regulatory and political conditions in a particular area. MaaS needs political support and an environment where it can grow. It even requires political investments to ensure/build an infrastructure with high quality [35][36]. Political investments are always made when there is some kind of pressure, for example via national or international climate or air pollution goals. Furthermore, a high-density area with a shortage of space could put pressure on the government and lead to investments in a new mobility concept. Another point is the pro-activity of the government, where problems in mobility might be foreseen [35]. One fundamental topic in this category is the regulation of data exchanges. MaaS is

built up on a high degree of collaboration between different participants, where data must be provided and exchanged. The last point is the regulation for passenger transportation. In this case, there should be a compromise between supporting MaaS and the quality of transportation [37].

The third category deals with economic conditions. One point is the profitability of a new mobility concept and the role of the platform provider or connector between customer and mobility provider (see Figure 5). First, the mobility sector has to be a market with a high degree of attractiveness. Not just for established companies in the mobility sector but also for start-ups and newcomers, it should be possible to compete and build a profitable business. Another important point is the critical mass and demand for a mobility service. Customers should have a high acceptance for new mobility concepts and be open for unknown possibilities, so platform and mobility provider become interested in investing in this business. In addition, this is very important for MaaS, as potential customers could switch from a privately-owned car to the idea of a shared ecosystem [38] [39]. Furthermore, a high density of population is necessary, because a higher number of participants affects a higher efficiency of the ecosystem. Especially in Germany, the support of the strong car industry is important. A restructuring of the mobility system is nearly impossible without the car industry – firstly, because of financial power and support they could give to implement MaaS; secondly, the cars themselves are a very important factor. For example, e-vehicles must be developed, which would provide the fleets for taxis, car-sharing and bus transportation [40].

The last category is the requirement of a highly-developed infrastructure. Therefore, the current mobility system should have a high diversity, quality, and willingness for collaborations. It is important to implement a new mobility system or, more accurately, a merging between existing mobility providers. Out of these categories, Schädel created an evaluation for North-Rhine-Westphalia (NRW) in Germany, the state with the highest population density in Germany. In this thesis, NRW can serve as model to examine the advantages and disadvantages of implementing MaaS in Germany. Table 1 shows Schädel's qualitative results. Regarding these categories, the conditions for a MaaS concept in North-Rhine-Westphalia are illustrated.

Technical conditions	
positive	negative
- high amount of solutions/applications with combined mobility offers (mostly on a pilot-project-level) - availability of paying services (e-Ticket), also for different tariff and mobility services - high and increasing distribution of smartphones	- existing pilot projects/ solutions are often limited to a special region or special functions → no nationwide and comprehensive offer available - insufficient Internet connection in some areas (e.g. on countryside)
Regulatory and political conditions	
positive	negative
- high political pressure due to - European air-pollution-directives - increasing congestions - national/international climate goals - European standardization of data-proving (GDPR)	- low degree of regulation-pro-activity (e.g. insufficient CsgG) - GDPR as obstacle to companies (innovation-driven and competitive disadvantage) - particularly strict interpretation of data regulations - PBefG hampers new mobility services → special protection of certain services; no free competition
Economic conditions	
positive	negative
- high demand for MaaS due to - increasing market for shared services - increasing acceptance of multimodal mobility services (also as substitute for a private car) - high population density - support of the car industry by providing own mobility services - supporting start-ups	- PBefG hampers development of new, innovative and profitable business models in the mobility sector - Questionable if the car industry "shares" the field of mobility services with other providers in the long term
Infrastructural conditions	
positive	negative
- increasing investments in the railroad infrastructure in the next few years - well-developed taxi-infrastructure (due to special protection by the PBefG) - good rental car infrastructure - comparatively well-developed offer of car- and bike-sharing services	- comparatively low investments in the railroad infrastructure in recent years and lack of employees (→ train-delays and -failures) - rising number of passengers in the next years - bad conditions for commercial ridesharing services due to the PBefG

Table 1 - Conditions for implementing MaaS in North-Rhine-Westphalia [13]

As it is shown, there are already many points that support MaaS. On the other hand, there are also arguments listed that show the work that must be done before a successful MaaS concept can exist.

The technical and economic conditions are well-developed throughout. Important factors like e-ticketing, high distribution of smartphones, the increasing market for sharing mobility and the support of the car industry are pillars for an adequate MaaS implementation [34]. Technically, especially a good-enough Internet connection must be improved, but plans for this have already been made. The government wants to speed up the process of greater Internet availability on a national scale [41]. Economically, the willingness of the car industry to share the field of mobility is questionable. Furthermore, the PBefG is preventing new business models and profitable opportunities.

This last point leads to two aspects that must be improved or changed. First, there are infrastructural conditions. There should be higher investments into the railroad system. Also, it is important to improve the customers' trust in the railroad system by improving its efficiency and cutting down on delays and cancellations. Dziekan and Zistel already worked out that a highly-trustable public transportation system is needed for its own efficient use [42]. On top of that, the previous year showed the need for investments. The *Sueddeutsche* newspaper wrote, at the end of the year: "The railway debacle - The railway was once a symbol of reliability. Today the state of emergency is often normal."[43].

Nevertheless, changing the regulatory and political involvement in the mobility sector is even more important. As already mentioned, the PBefG is outdated and should be revised or updated, so that more competition between all players is ensured. At the moment, taxi services for instance are protected by PBefG [44]. For more competition, an integration of car-sharing and on-demand services would create a competitive and balanced mobility system. Another essential point is a pro-active behaviour of the government. The initiated CsgG, which should help on-demand and ride-sharing services to develop, is not an adequate law to trigger a development in these sectors. Especially the visibility of these services could be improved and lead to a higher awareness of the services. Based on this and the knowledge that these services are a core element for MaaS, a higher involvement of the government and pro-activity are necessary for a suitable implementation of MaaS.

3   The Role of E-Mobility within MaaS

E-mobility is often equated with e-vehicles, but E-Mobility encompasses all kinds of transportation solutions operated by an electric motor. The German government formulates it this way:

> *Electric mobility, according to the definition of the German government and the National Development Plan for Electric Mobility (NEP) comprises all street vehicles that are powered by an electric motor and primarily get their energy from the power grid – in other words: can be recharged externally [45].*

E-mobility includes e-vehicles, electric bicycles, electric buses, electric scooters, trains, trams, etc. This variety of transportation solutions is one aspect that speaks for the importance of e-mobility within the ecosystem of MaaS. In this Chapter, the opportunities and challenges regarding the implementation of e-mobility within MaaS will be presented. Thus, it will be analysed how e-mobility fits into the categories presented in Chapter 2.2 that are required for a successful MaaS integration (see Table 1). Furthermore, it will be displayed how e-mobility and especially e-vehicles can benefit from the multimodal system of MaaS.

3.1 Political conditions

In this first part, the regulatory and political conditions of Germany will be examined. Therefore, it is necessary to point out how the government is aware of the need for a change in the mobility sector and, on the other hand, which actions or legislation are *en route*. Especially the pro-activity, which has been mentioned in Chapter 2.2, is very important in this context.

The awareness of the German government is very high. Many promotions regarding E-vehicles, mobility, and new transport technologies or even in new concepts for mobility[45], are executeted, as it can be seen in Table 2 [46]. According to a website of the German government, several different ministries are involved in this topic. This shows the importance of the topic.

Table 2 displays the different funding programmes of the German government regarding E-mobility.

Funding priorities – E-Mobility			
BMWi[1]	BMVI[2]	BMBF[3]	BMUB[4]
1. ICT for electro mobility 2.Vehicle-compatible battery systems (market-oriented development) and corresponding production technologies 3. Electricity key elements of electro-mobility: storage, networks, integration 4. Technologies for the drive systems of electric and hybrid vehicles 5. safe and efficient vehicle operation 6. Charging infrastructure (with BMVI) 7. Accounting systems 8. User acceptance (with BMVI)	1. Safety of batteries from mass production 2. Demonstration and testing of innovative mobility systems 3. Charging infrastructure (with BMWi) 4. Safety and efficiency of vehicle fleets 5. Hybridization of trucks, increasing efficiency ancillaries 6. Traffic safety 7. User acceptance (with BMWi)	1. Cell and battery development (battery concepts and management) 2. Research and development on novel materials 3. Production research for future battery generations 4. Fail-safe components and systems 5. Systems Research Electro mobility 6. ICT for energy efficiency in the electric vehicle 7. Initial and continuing education	1. Demonstration and testing to determine the environmental and climatic factors of electro-mobility 2. Coupling electro-mobility to renewable energies and their grid integration 3. Environmental and climate-related concepts 4. Market introduction with ecological standards 5. Research and development on recycling processes, ecological and energy balances of the components

Table 2 - Funding priorities of the German government regarding E-mobility [46]

As it is displayed, the different ministries work on mostly different topics regarding e-mobility. The funding of these research project is based on the climate protection plan from 2010. Within the plan are goals formulated for the timeframe until 2050, to increase energy efficiency, the expansion of renewable energy production, and the reduction of greenhouse gases. More in detail, the consumption of primary energy should be decreased by 50% in comparison to the measurements in 2008, the production of renewable energy shall increase by 60% and the greenhouse emissions shall be decreased by at least 80% compared to the year 1990 [48]. To reach the goals, a complete turnaround in all levels of the energy consumption chain must follow. Particularly the need for new technologies, which are sophisticated and can be operated economically, is fundamental. For governmental funding, research projects must fulfil one of the following major focal points:

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[1] Federal Ministry for economics and energy

[2] Federal Ministry for transportation and digital infrastructure

[3] Federal Ministry for Education and research

[4] Federal Ministry for the environment, nature conversation and nuclear safety

1. Consumption of energy
2. Energy supply
3. System integration
4. Cross-system research topics

Projects in various fields can apply for funding, for example housing, industry or renewable energy production solutions, such as wind energy or photovoltaic. But also mobility and especially e-mobility, digitalisation within the context of energy and the grid system are crucial points within this schedule [49]. This is only one aspect that proves politicians' awareness of the need for a change within the production, consumption, and efficiency of energy in everyday life. In addition, the statements of the government show the importance of this topic:

In the coalition agreement, further measures were agreed: the legal facilitation of the installation of charging points for tenants and apartment owners, the introduction of a special depreciation for commercial electric vehicles and the increase of the purchase price for electric taxis and light commercial vehicles with electric drive.

Angela Merkel (chancellor of Germany) on the actions of the government to implement E-Mobility in Germany [50]

[...]For years, we have been promoting a wide range of products that enable efficient, modern, intelligent, clean and safe mobility... In the coming years, we will make another billion available to push this forward [...].

Andreas Scheuer (Minister for transport and digital infrastructure) on his speech at the house of representatives for budget set for 2019 [51]

However, there are also negative aspects that must be shown. In Chapter 2.2, it was already explained that some changes must be implemented for an adequate MaaS system. Most important are the regulations for the data exchange, the PBefG, and the pro-activity. The current data exchange rules inhibit the organization of a successful platform, which can give transportation solutions quickly, reliably and easily. Further, the pro-activity of the government would help MaaS to develop faster, and problems within the regulations would be identified earlier. Even more important is that the public infrastructure will be dramatically expanded, so customers would

loose their doubts about the range of e-vehicles. Nevertheless, the most important problem at the moment is the PBefG. It hampers the development of new and profitable mobility concepts such as MaaS.

In summary, the government is aware of the need for a change in the German mobility system. As in the previous Chapters showed, MaaS is one solution to implement the required changes. Also, the implementation of e-mobility into the transportation sector can be accelerated. However, changes within the speed of execution (pro-active behaviour) and the total support for new mobility concepts, by lowering the limitations within the consistent with regulations. Furthermore, own involvement in building charging stations and Internet infrastructure is necessary. This topic will be explained in more detail in later sections (3.2 - 3.4).

3.2   Infrastructural conditions

The charging infrastructure for e-vehicles is one of the most-discussed topics in society and research regarding e-vehicles [52]. One problem is the low range of batteries compared to vehicles with conventional motors, as in Figure 7 showcases.
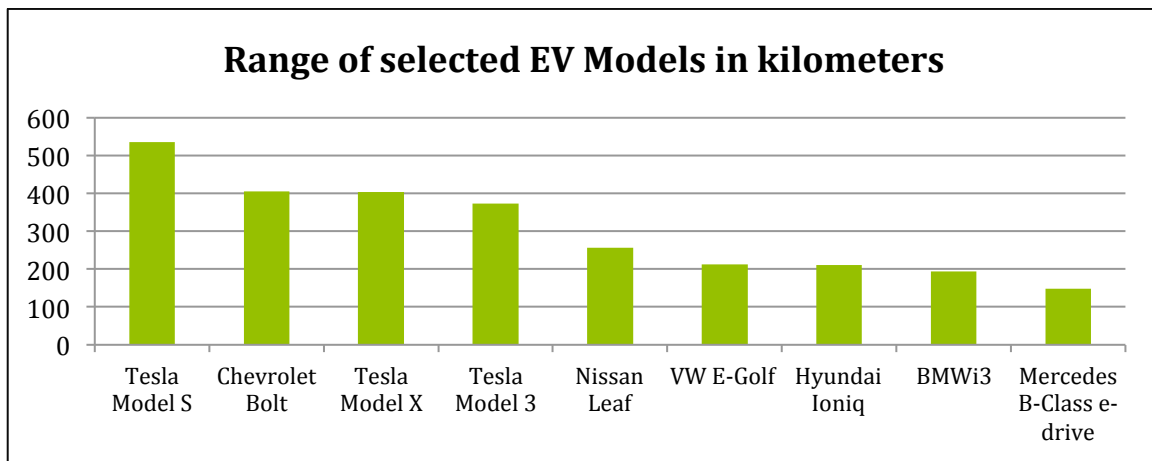
Figure 7 – Range of selected EV Models (Nov 2018), transformed from [53]

Furthermore, the availability of public charging stations is insufficient. This is one reason for the low market penetration [54]. Due to this, the development of a demand-driven charging infrastructure is necessary to increase the number of e-vehicles in Germany. Charging infrastructure can be divided into three types: first, privately-owned charging stations, which belong to certain people and are located

on private property. This option is used for over-night charging at home for a longer period and requires only 3.7 to 11kW to charge the car [11]. The cost for a home-based charging station varies between 200 and 1,250 Euros [55]. There is also the opportunity to install semi-public charging infrastructures like public stations, set on private property and not accessible to everyone. For example, these stations could be placed on supermarket or employee car parks. The charging power here depends on the usage. If a faster charging is needed because the load time is short, a charging station with power up to 22,2kW is required [11]. Costs for such semi-public stations can rise up to 3,250 Euros but can be used as marketing action to acquire new customers [56]. The last option is public charging, where every customer can charge their car. These charging stations are mainly for users without a private charging station or for long-distance trips. For this, an ultra-fast charging station is necessary, with a connection of up to 100kW. The costs for such a system are starting from 50,000 Euros [41][58].

As already mentioned, regarding political conditions of a mobility system with high use of e-vehicles and other kinds of e-mobility, concepts are needed. Therefore, a satisfactory infrastructure must be built. With the current and presented technical possibilities, MaaS would especially create more economically feasible conditions to build a semi-public and public charging infrastructure. This is due to the fact that firstly, car-sharing providers would offer themselves an adequate, station-based charging infrastructure. Secondly, the government would support building a public charging infrastructure to assuage customers' fears regarding low range. Additionally, MaaS would provide transport solutions that are based on all available mobility providers, such as public transportation.

3.3   Technical opportunities

The technical opportunities were already partly mentioned above. They will be summarized and supplemented by a few more aspects.

As was already presented, MaaS needs a charging infrastructure based on semi-public or public charging stations. Sharing providers will need to build a semi-public charging infrastructure for their station-based system. Furthermore, free-floating offers require a public charging opportunity [59][60]. Against this need of charging

infrastructure for MaaS, Bergfeld et all. show a different development, where mostly 85% of the charging infrastructure will be privately owned [61]. This is, on the one hand, due to the low involvement of the government and, on the other hand, caused by the fact that e-vehicles are not rentable at the moment (see 3.4). As described, a high degree of public and semi-public charging infrastructure would not only provide the base for the concept of MaaS, it would also provide the opportunity to help the grid system regarding its power quality problems [62][63].

In general, the main idea of MaaS is that large car sharing fleets have many advantages. It should be observed that trading at the energy market in Germany is only allowed from a trading amount of one megawatt [64][65]. Large sharing fleets with a high number of e-vehicles and charging stations could feed the energy system with power when it is needed or take out more energy to stabilise the grid system. Conversely, the pooling of e-vehicles into fleets would decrease car variety and within that the different types of charging technologies. This would greatly decrease the complexity of the integration of e-vehicles.
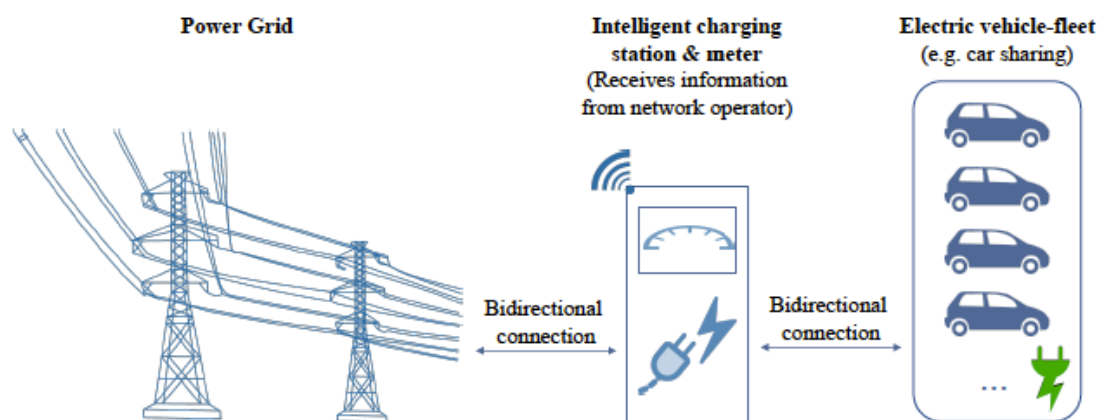
Figure 8 - V2G concept with electric car fleets [13]

Nevertheless, possible customers complain about the low range of e-vehicles and their concerns regarding this new technology. Therefore, the integration of this system within MaaS, as a multimodal concept with different mobility opportunities, would provide a solution for every purpose.

3.4 Economic conditions

In this Chapter, the economic conditions for the integration of e-vehicles will be analysed, as well as the changes that must be implemented to make e-vehicles within fleets profitable.

Regarding different studies, it is not profitable to operate e-vehicles in sharing fleets. Currently, there are three different types of providers. First, there are new sharing providers who are participating in an e-vehicle project or are part of a programme of cities. The second type of providers are car companies who want to promote their own e-vehicles in their sharing fleets, like car2go by Daimler (car2go). The last types are sharing providers, who receive funding by the government for integrating e-vehicles into their fleets. All these providers cannot operate e-vehicles in a way that make them profitable [60], [64].

As already mentioned in previous Chapters, such as in 3.1, the opportunity to create new business models and the creation of a high utilization rate is necessary to make it profitable. Therefore, the role of the government is very important. The support and encouragement are very important to convince people in Germany of the advantages of e-vehicles, give up the concept of privately-owned cars and participate in the ecosystem of sharing. To provide customers with more trust, the multimodal concept of MaaS could bring more safety and the opportunity to create a mass market, which would make the operation of e-vehicles profitable.

3.5 Opportunities and challenges

In this Chapter, the benefits of MaaS for the integration of e-mobility and especially e-vehicles were displayed. Also, the challenges to initiate and implement e-mobility were shown. In this part, they will be summarized and displayed in a table.

E-Mobility within MaaS

opportunities	**challenges**
• Easier way to implement e-mobility through MaaS • Supporting power quality issues through MaaS and sharing fleets • Multimodal concept gives the opportunity to implement e-vehicles with lower range • Development of charging infrastructure and mobility services ensure a high utilization • Implementation of e-vehicles without alternative, due to climate goals	• Current regulations inhibit development of new business models, which are necessary for profit • External funding is necessary for implementation of e-vehicles • Low involvement of government in building charging infrastructure • Expansion of public and semi-public infrastructure needed

Table 3 - Opportunities and challenges for implementing e-mobility

All in all, MaaS provides the environment needed to promote the utilization of e-vehicles in Germany. Furthermore, it was shown that Germany needs a change within the mobility sector, rather than just replacing conventional cars with e-vehicles. The most important challenge for a successful implementation of e-vehicles is an easy access for the customers through a multimodal system. In addition, users of MaaS would not have to invest a high amount of money to buy an e-vehicle and the suitable charging infrastructure. Even more important is that MaaS provides an all-around service with the best travel opportunities and the best providers individually. To achieve this, MaaS fulfils many requirements, such as **multimodality** and **service orientation,** to integrate e-vehicles in Germany. Therefore, the most important issue is solving the remaining challenges that are presented in this Chapter and in Table 3. For this, the highest priority is the development of a public and semi-public charging infrastructure and of new business models, to ensure the profitability [60][66].

The previous Chapters presented, on the one hand, the theoretical background of MaaS and the role of E-Mobility within it. On the other hand, they showed the necessity for a change in the mobility system and also the willingness of the government in particular to enforce these changes. As already explained in the introduction, the concept of MaaS at the heart of this thesis. To answer the main hypothesis, it is necessary to get inside information of a country where MaaS is already implemented. Therefore, interviews in Finland will be conducted, as presented in the following Chapter.

4   Methodology

In this Chapter, the methodical execution of this work will be presented and explained. As already mentioned, this work follows an empirical research, where experts will be interviewed. This method is a qualitative research method and was chosen in this thesis over the quantitative approach. The reason for a qualitative method is the low knowledge in this field; the amount of quantitative information is limited.

Qualitative expert interviews are, according to the definition of Robert Kaiser, a systematic and theory-based method of data collection. In this form of data mining, people are questioned who have exclusive and special knowledge about strategies, processes, instruments and the mode of action within the chosen topic [67].

In this Chapter, the approach of a qualitative interview will be introduced. In the next step, this will be adapted to the structure of this thesis.

4.1 Qualitative expert interviews

As already mentioned, qualitative expert interviews are the method that will be used to gather relevant information to answer the main hypotheses. In academic literature, it is mentioned that there are three different types of qualitative expert interviews. First, there is the explorative expert interview. Such interviews are conducted for general information searches. They are mostly used in cases where less research was done beforehand, to work out a hypothesis, to prepare a systematic general inspection or for exploring a new field of research. Next is the guide-supported expert interview, which is a more structured form of interrogation to exploit hard facts. These hard facts cannot be found in literature or other resources. By using an interview guideline, specific knowledge will be retrieved in order to get precise answers. This knowledge is necessary to answer the research approach. The last type of qualitative expert interviews is the plausibility conversation, which can be held after an empirical research programme. Its function is to get advice for the presentation afterwards or if the deliverables are reasonable and suitable for daily use.

As already mentioned in the introduction, the interviews were conducted in Finland and in Germany. Based on these, a guideline for MaaS in Germany is created. These interviews shall provide information that cannot be found in literature and, in addition, give hard facts to the inside of Finnish and German knowledge about MaaS. This information is necessary to answer the thesis's questions. This leads to the guide-supported interview category, which fulfils the requirements for this thesis.

4.2 Proceeding and approach

In this part of the thesis, the proceeding for preparing, executing and analysing interviews will be explained and brought in correlation with the thesis. According to Robert Kaiser's book "*Qualitative Experteninterviews",* there are ten steps to conduct an expert interview[67]. At first, the **development of an interview guideline** is the most important part when executing expert interviews. In Table 4 one can see different kind of question types that can be used during the interview. The interviewer can decide which kind of question will be used and needs an appropriate handling for various situations and atmospheres. The full process, which leans on the concept of Mayring's work *"Einführung in die qualitative Sozialforschung: eine Anleitung zu qualitativem Denken",* will be described in more detail in 4.5 for Finland and 4.6 for Germany [68]. The full interview guideline can be found in Annex B (Interview guideline Finland)[67], [69].

	Research context: "E-Vehicles within MaaS
Introductory Questions	You know the concept of MaaS. When did you first get in contact with it?
Structuring Questions	Regarding the previous mentioned point, I would like to examine this topic under a different aspect. In which way could MaaS support the utilisation of E-Vehicles?
Direct Questions	How can the government support the idea of MaaS and which benefit would it bring?
Indirect Questions	Which advantage would the automobile industry have from MaaS?
Specifying Questions	You already mentioned what role the government has to take to implement MaaS within a country. Could you carry out the specific task or role of the government ?
Interpretive Questions	Imagine all participants in Germany would agree to the concept of MaaS. How long would it, in your opinion, take to fully implement the idea of MaaS?

Table 4 - Diverse question types within an expert interview [69]

The next step is the **pre-test of the interview guideline.** This has two functions.: the first check of structure and personal ability to adapt to different situations within an interview; the comprehension of the questions, the continuity of the interview, and the duration can be reviewed [70].

Thirdly, the selection of appropriate interview partners and the contacting must be done. The position and the status of the person can be important for the selection of interview partners. A person can be an expert if they were or are still involved in the process of interest. Furthermore, an expert can also have functional knowledge, which they already showed in, for example, a publication or an interview [71].

After these three steps, the preparations for the interviews are finished. In the next step, the interviews can be carried out. During the interviews, different kind of effects between the interviewer and the expert can appear. The first is the iceberg effect, where experts manifestly withhold available information because of suspiciousness and lack of interest. Another would be the paternalism effect, which describes a mostly dominated conversation of the expert, in which the opinion of the expert is the only one relevant. The feedback effect is the next. Here, the experts turn around the question-answer situation and ask the researcher questions that interest them the most. In the end, there is also the catharsis effect, which describes a situation where the experts promote themselves and show their higher status over the researcher [72].

The last part in the execution of interviews is the logging of the interview. Logging means just a brief summary of the most important facts of the interview, like emotions during some statements. Furthermore, the duration of important and unimportant passages can be written down. This summary will help during the analysis of the interview.

The next section within the analysis of interviews is the evaluation of the material [72], [73]. At first, the material must be secured, which can be done in three different ways. Firstly, a detailed transcription of the material can be made, where every word and every mentioned detail must be written down. Important is that passages of different people and fragmentary passages are clearly marked. The second way of saving the interview material is to paraphrase the interview, so the interview is

textually depicted. It must be pointed out that previous information, sentiments and interpretations are unchanged. The only parts that can be reduced are iterations of redundant passages. Paraphrased passages must be pointed out and chronologically processed. The third option is to exemplify a commemoration memory. This way of securing the data from the interview does not use recorded interview material. It is a way of approach where the interviewer writes down what is in their memory. This execution can be done if the expert does not want to have a recorded interview. The problem with this procedure is that just important sections for the interviewer will be saved and other fragments of the interview are lost.

For this thesis, it was necessary to record the interviews, because detailed information regarding the procedure of the government to implement a new mobility concept is important. Furthermore, it was agreed that paraphrasing passages without important information would be allowed, so the number of interviews within the time could be increased.

Coding the material is the next part of analysing it. At first, there a decision must be made regarding the accuracy of the material's categorization. It can be done for every sentence, every passage or every paragraph. In this case, every passage, which includes one full statement, will be summarized and named in a category. These categories must be previously determined and be worded in an adequate manner [67].

In the next step, the interviews will be merged together and coded. Coding means, in this case, that statements of different experts will be merged based on the previously-mentioned categories. From this aspect, the chronology of the interviews will be drawn. Through these summaries, double statements can be identified and merged together. This procedure reduces the amount of the initial material. Even more important is that, for the first time, it is obvious how much each category was discussed during the interviews. Furthermore, it becomes evident whether experts support each other's statements or if they have different opinions regarding one category. Based on this, is possible to interpret and analyse the expert interviews with the further given theoretical instruments [72].

For the next step, the interviews must be combined with further knowledge from

academic literature. This step has to be performed if some categories were not processed in a sufficient way during the interviews or the statements were not significant enough. Furthermore, statements from experts can be backed up with literature, which would make them more reliable.

The last part of the analysis is the theoretically-guided interpretation of the material. In this part the statements, which were merged into categories, will be related to the main hypothesis of the paper. Here, it is important to display all different opinions without weighting the statements [67], [72].

In the next two Chapters, the interviews for Finland (see Chapter 5) and Germany (see Chapter 6) will be analysed. Here especially, the detailed examination of the interviews presented is very important.

The goals for the interviews in Finland are:

1. Obtain an inside view about MaaS
2. Role of the government for implementing MaaS
3. The role of MaaS for the implementation of e-vehicles
4. Timeframe for a smooth implementation of MaaS

The goals for the interviews in Germany:

1. Obtain an inside view on future models of mobility in Germany
2. Which role will the government take in implementing a change?
3. The plan for increasing the utilization of e-vehicles (business models)
4. Knowledge about MaaS and possible implementations

4.3   Execution of interviews

The expert interview itself is a special communicative situation. It is an essential condition to success, by being aware of different situations (see Iceberg) and using the right conclusion to master these situations. In this part, some examples will be shown, where the provision through the interviews and the reaction to the answers can be seen.

The interviews always started with some small talk about the author's time in Finland. At the end of this, the author guided the conversation to the main topic: "Mobility-as-a-Service". At that point, the interviewees were asked if the interviewer could record the interview. For data security reasons, the participants were given the opportunity to sign a contract, where the workings of the recordings and the option to delete passages afterwards in the transcription were described. From this point on, the recording and the actual important information-gathering started.

Each interview started with a short presentation by the expert themselves. Questions about the career and some personal facts where asked. Further, the expert was asked to give information about when and where they first got in touch with the idea of MaaS. The answers to this first part where so different, that from this point on the interviews needed be divided in two different groups. On the one hand, there were experts who just answered the given question curtly, as for example Tommi Lampikoski and Mika Kulmala. On the other hand, there were the experts who already went further on the idea behind MaaS, like for example their personal involvement in this topic or the reason for there being a change in the mobility concept. For easy explanation, the further descriptions will be divided along the lines of these two groups, so the actual guide trough the interview can be displayed and the advantages and disadvantages of both types shown.

The execution of the interviews of the **first group** went exactly as planned. So, after the introductory questions, the further categories could be asked chronologically, as was predicted in the interview guideline (see Table 15 in Annex B). Another advantage is the easier analysis of the interviews, because the given answers are already sorted to the specific category. However, the most important point is the possibility to ask specific questions for more detailed information, which can lead to more detailed results. On the other hand, the interviewer has to pay attention and ask for more specific information. Furthermore, the expert will not give hints to further topics or additional material that was previously not in the scope and could help analyse this topic. For example, the additional materials given by Krista Huhtala-Jenks and Laura Eiro helped clarify the concept and idea behind the new mobility concept in Finland (see 5.4). In Table 5 the described advantages and disadvantages are summarized, and further effects are mentioned.

First group of interview experts	
Advantages	**Disadvantages**
• Chronology of the interview according the interview guideline • Time for specific questions • Easy to analyse	• Less detailed information • Specific information has to be constantly requested • Further information is not given

Table 5 - Advantages and disadvantages of first interview grouping

The second group of experts, as already mentioned, was very informative. Much additional material was handed in and even new topics came up. So, especially the amount of information that was discussed by these experts was very satisfactory. Nevertheless, on the other hand, the time for specific questions is sometimes short, as for example at the end of Krista Huhtala-Jenks's interview, where more questions regarding e-mobility and the vision for Germany could have been interesting. Another point is the analysis of the interviews, which are very unstructured, as well as information given to different categories. Furthermore, the previous set-up of the interview guideline had to be adapted by the interviewer during the interview (Noora Lähde). On top of that, the amount of given information must first be overviewed during the interview, and additional questions regarding specific topics may not occur.

Second group of interview experts	
Advantages	**Disadvantages**
• Further material can be given • Information about new topics can be added • Explanation of the concept very detailed	• Established interview guideline has to be adapted during the interview • Time pressure because of too much information about other topics • Information has to be structured during analysing to regarding categories • High awareness during the interview → specific topics may not be brought up

Table 6 - Advantages and disadvantages of second interview grouping

It should be mentioned that these are just the estimates by the author, which were written down during the interviews and their analysis. In addition, not all of the participants can be clearly placed in one of these groups. There is, for example, Tommi Lampikoski, who would fit in the first group regarding his answering style, but who, on the other hand, provided much additional material and information, which helped better clarify governmental work within the changing process as well as the opportunities and challenges of MaaS.

After ending the different interviews, the author always took time to write down some notes, where emotions, important passages or statements were marked. Checking the audio quality was vital. This procedure helped, especially during the analysis of the interviews.

Overall, at this point, it must be mentioned that the willingness to share and provide further information in Finland was very high, and the whole communication during the interviews was on an even level. In advance, the experts also offered their time, should more questions arise in the future.

4.4 Analysing interviews

After the conduction of the interviews, the evaluation of the material follows. First part here is the transcription of the audio material of each interview. For this thesis the interviews will be paraphrased and not fully transcribed. The paraphrasing in this case will use the following rules:

1. Questions and answers will be written in full sentences
2. As close as possible to the spoken word
    a. Implementing missing words
    b. Elimination of filler words
    c. Correcting to appropriate language
3. Eliminating of unimportant parts
4. Marking passages that are not understandable
5. The result is given to the expert so they can confirm the meaning

These rules show that the only change to a full transcription is the adding of missing words, elimination of filler words, and the correcting to appropriate language. Furthermore, the author may eliminate unimportant parts that do not concern the actual topic. An important part is that passages where the spoken word is not understandable are marked.

All in all, the spoken word and the meaning of the passage in particular will be not changed. For proof, the written transcript will be sent to the expert and checked to prevent misunderstandings.

In the next step, each interview will be coded regarding the rules of Mayring, which are presented in Chapter 4 [72] and shown in Figure 9:

| Line | Transcription | Paraphrase | Generalisation | Category |
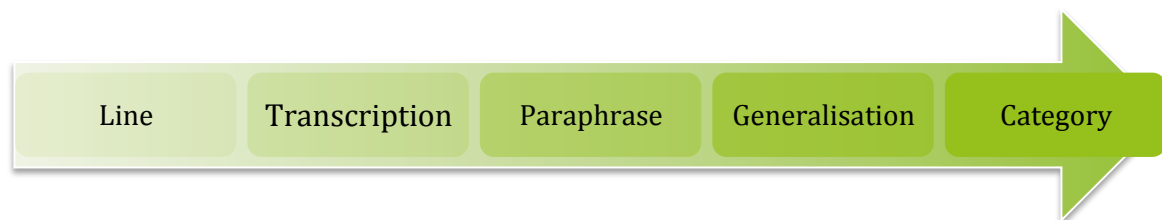
Figure 9 - Analysis of interviews according to Mayring

As Table 7 shows, the interview will be divided in paragraphs, where just one topic is mentioned. Important is the location (line) of the mentioned passage, so it can easily be found afterwards if the context needs to be checked. After the transcribed passage is inserted (transcription), this passage will be paraphrased. Here, just the important key facts will be mentioned, i.e. the ones that concern the category (paraphrase). In the next step, the paraphrased passages will be generalised, where short key points of this passage will be mentioned. This will help provide a quick overview of the topic within the passage and can help in further steps, i.e. to find similar passages from other experts (generalisation). In the last part, the passage will be classified in a category. Categories were created during the development of the interview guideline (see Table 15 in Annex B). As example, the following statements of Tommi Lampikoski will be shown:

Line	Transcription	Paraphrase	Generalisation	Category
167-171	Another thing is, if you can't guarantee D2D Mobility, it will be very hard to move masses of consumers. You really have to pick up the service level and automotive services will play a big role, when and if they come. At least a lot of promising pilots are going on in the US. Once that comes [,] you can really do it in a lower cost type of way.	Another thing is, if you can't guarantee D2D Mobility, it will be very hard to move masses of consumers. You really have to pick up the service level, and automotive services will play a big role. Once that comes, you can really do it in a lower cost type of way.	D2D-Service	Implement ation - Properties
171-173	I think there is potential in [ridesharing], but [ridesharing] with people you don't know is problematic. On the other hand [,] ride sharing with kind a like people you know from your neighbourhood or from workplace, would work a lot better.	I think the problem with ridesharing is that people are not willing to share with people they don't know.	Ridesharing implementatio n	Implement ation – Properties
89-95	I think the key issue is that transport sector is really a major source of greenhouse gas. I really advise you the link to our report, where this is one of the key factors. Finland and especially Sweden have really aggressive goals of leading to reduce the emissions by 50%. I think in Finland its by 20 or 30%. Nobody has a real clue how to achieve that. So we pointed out a lot of things in the report, what should be done and I think that is one of the key issue, that everybody shouldn't drive with their own car. Why not using this type of services.	I think the key issue is that the transport sector is really a major source of greenhouse gas. Sweden and Finland have really aggressive climate goals, where emissions have to be reduced by 50%, but nobody has a clue how to reach these goals.	Emission Goals	Need of Change

Table 7 – Example for Mayring-Reduction

At this point, it is already clear where the expert has provided more information and what he chose to focus on. Krista Huhtala-Jenks, for example, gave ten (25,7%) statements regarding the governmental role in the implementation of MaaS and one (2,5%) about current customer satisfaction with MaaS [76]. Whereas Mika Kulmala gave 14 (41,2%) statements regarding the governmental role in the implementation of MaaS and also one (2,9%) about the current customers satisfaction with MaaS [77]. The following table displays the absolute and relative number of given statements by each interviewer (see Table 12 in Annex B).

Important to mention is that the previous structure of the interview in seven categories was extended to eight. The reason is the amount of answers concerning the topic of satisfaction with the MaaS concept in Finland. Furthermore, the interviews showed the importance of the satisfaction level of the people/customers. Noora Lähde from the Transport and Safety Agency says:

It depends on quite many things, but actually mostly on the users in the end, because it's about them.

Noora Lähde [78]

The coded tables allow, in three further partial steps, to analyse the material. Firstly, on the basis of the categorical coding, it is now possible to recognize where each expert made statements that belong together thematically. These will be summarized under the categories, and the previous chronological interview will be abandoned. Important at this point is that the essence of the statement in the transcriptions will be kept, in case of later ambiguity about the context. At this point, duplications can be eliminated, so that the material for the analysis is reduced and clearer. Each of the interviews is now categorically sorted and condensed, so that in the second part, the information of all interviews can be combined. For the first time, it becomes visible where experts had the same opinion, where they disagreed with each other, and which topics were covered more often. In the last step, it is now possible to identify core messages of all expert interviews. Table 8 shows an excerpt of the category "Reason for MaaS", where similar statements were marked. In the end, for the sake of the material's interpretation, they will be combined into one main statement.

Transcription	Paraphrase	Generalisation	Category
The second thing, which felt important was that with MaaS we also able to look at influences of climate change, which I have to say was not that hot [a] topic in 2015. It was important, but it was not the way it is actually now. Only a few years later the topic of climate change sort of overwhelming us. That was not the case in the summer of 2015 - Not as I remember it.	The second and for me even more important part was that we could influence the climate impact. In 2015, it wasn't that topic, but now it's gaining a lot of attention.	Tackle climate change	Reason for MaaS
Because of for Example climate	Because of the climate	Climate Change	Reason for

change and this kind of environmental things. This is one thing and of course for example in city centrums there's no space for cars so much.	goals, the environmental change and in city centres, there is not that much space for private cars.	No space for private car	MaaS

Table 8 – Similar statements of the category Reason for MaaS

> One reason for the majority of the interview partners to change the mobility system to MaaS is the big environmental potential, where one big step can be taken to reach the climate goals, which where presented in chapter 1 and chapter 2.1.

Figure 10 - Main statement out of Table 9

In the next Chapter, the main statements of each category will be displayed and put in the context of the thesis.

4.5   Prearrangement: Finland

In Chapter 4.2, it was shown that the first step to prepare an interview is the production of an interview guideline. Figure 11 shows the process from the research question up to the interview questions.

| Question of interest | Breakdown dimensions | Batteries of questions | Interview questions |
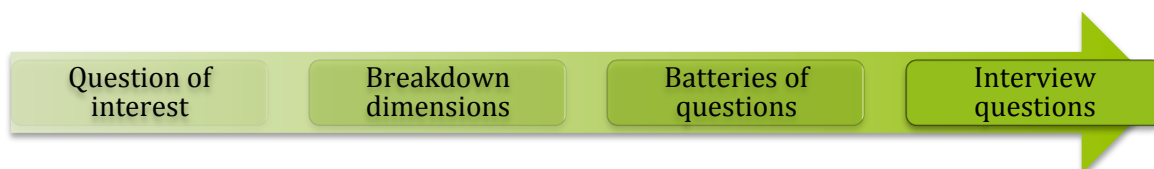
Figure 11 - Preparing interview questions [72]

For the interviews in Finland, the following table shows this procedure and explains how the role of the public administration within the implementation of e-mobility throughout MaaS will be identified. As displayed, the main question for this Chapter is the identification of parameters how MaaS can be implemented. For this, five categories (breakdown dimensions) were identified, which describe the most important factors. These categories are worded as questions in the next step (batteries of question) and then refined into interview questions. As can be seen, to each question are further questions, which can be used as additional material to, for example, get more detailed information or an interpretation of a situation. These further questions are based on the concept of Table 4, which is presented in Chapter

4.2. To showcase, one line of developing an interview question will be presented in the following.

Question of interest	Breakdown dimensions	Batteries of Questions	Interview questions
How can a new mobility concept be implemented in Germany	Change of the mobility concept	Why was a change in the mobility concept necessary?	Why is Finland implementing a change in the mobility concept? ○ ST: Could you amplify your previously mentioned point regarding … ○ ST: The previously mentioned point you said, I would like to examine under a different aspect. In which way could MaaS support… ▪ Outdated mobility concept ▪ Greater efficiency ▪ Greenhouse gases ▪ Digitalization

Table 9 - Example for developing the interview guideline for Finland (Full guideline in Annex B Table 15

The main function of this Chapter is the identification of detailed facts about the procedure of implementing MaaS. One point for a successful implementation is to figure out why a new mobility concept is needed, because humans are fond of sticking to current and already-known patterns [74]. Therefore, the main question will be *"Why is Finland implementing a change in the mobility concept?"*. For more detailed information, further questions can be used, especially structured questions like, *"The previously mentioned point you said, I would like to examine under a different aspect. In which way could MaaS support the use of the current technologies".* The further categories are, firstly, the reason why especially MaaS was elected as new mobility concept. The longest and largest part of the interview will be the category of implementing MaaS, where questions regarding a concept, the timeline and the reaction/acceptance of the customers are the main topic. In the next category, the role of e-mobility is tackled, so importance and advantages can be identified throughout the interviews. The implementation of e-vehicles will play an essential role, because of the significance of the automobile industry in Germany [75]. As last category, the possibility of implementing MaaS in Germany will be discussed on a highly interpretative level.

The next step in the preparation of a qualitative expert interview is the **pre-test.** The pre-test was conducted with friends, where especially the right vocabulary and amount of questions was adjusted. Furthermore, it was mentioned that a higher degree of free-talking and reacting to the conversation is necessary to achieve a more comfortable atmosphere in the interview.

After editing the previously-mentioned points in the pre-test, the next step can be taken. The selection and contacting of experts are important according to the criteria of Chapter 4.2. Therefore, the list of experts was worked out in cooperation with Heikki Liimatainen, who himself is a recognized expert in the field of mobility. Table 13 in Annex B shows the contacted experts, their position and the date of interview. Furthermore, a brief description of the reason for electing these experts is given.

After reaching an interview acceptance rate of over 90% in Finland, the interest in Finland can be seen as very high. Responses were very friendly and contacts to other people were offered.

Further down, the execution and editing of the interviews will be shown.

4.6   Prearrangements: Germany

The conditions for the interviews are mostly the same as in Finland (Chapter 4.5-4.4). Differences can first be found among the interview partners, as Table 14 in Annex B shows. It has to be mentioned that the willingness to participate in this project as an expert was much lower. Just 4 out of 17 contacted people offered help to find the right person to interview or participate as an expert.

In the next step, the interview guideline has to be adapted to the main questions within this Chapter and to the already obtained information from the Finnish interviews. It has to be mentioned that the conduction of the interviews was mainly fully open and just a few main questions along the main structure helped as thread through the interviews. The advantage of this almost fully open interview is the amount of information and the detailed knowledge, which can be received from the experts without guiding the interviews through special topics.

Main guideline for all interviews is:

Need of Change	Why is the topic of changing the mobility concept coming up in Germany?
Implementation Properties	What are the prerequisites for the new mobility concept? What do you understand under Mobility-as-a-Service?
Implementation Government	What are you planning here at the ministry/council for the future of mobility? (for Carsten Wolff, Jens Petershöfer & Hartmut Reupke) What is the role of the government within these essential changes in mobility? (Michael Kuhn)
E-Mobility	Why is e-mobility one part of the changes and how can e-mobility provide an essential contribution to the changes?

Table 10 - interview guideline for Germany

The mentioned main structure remains the same and just the last part will be eliminated, as the interview guideline already points out.
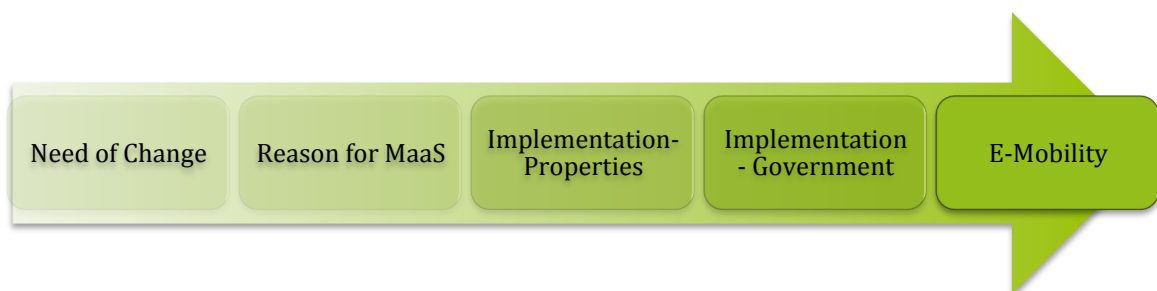
Figure 12 - Main Structure

In summary, the preparation for the interviews in Germany includes just a few changes to the Finnish interviews. Furthermore, compared to the latter, it was less important to gather information regarding special topics and, rather, an overview was gleaned of the current situation and the current plans of the government and the automobile industry.

5   Results of the Interviews: Finland

As already described above, the knowledge of the Finnish government about MaaS shall help understand the ecosystem and identify the role of the public administration to implement it in a country. Therefore, the previously-mentioned methodology of qualitative expert interviews will be used to examine this topic. In this Chapter, the process going from preparing over executing to analysing the interviews will be presented.

In Chapter 4.5, it was shown that the interviews are structured in seven categories, which were extended to eight during the interviews (see Chapter 4.4). For all statements, the basis are the interviews with the experts, which are presented in Table 13.

Need of Change	Reason for MaaS	Implementation-Properties	Implementation - Government	E-Mobility	Germany
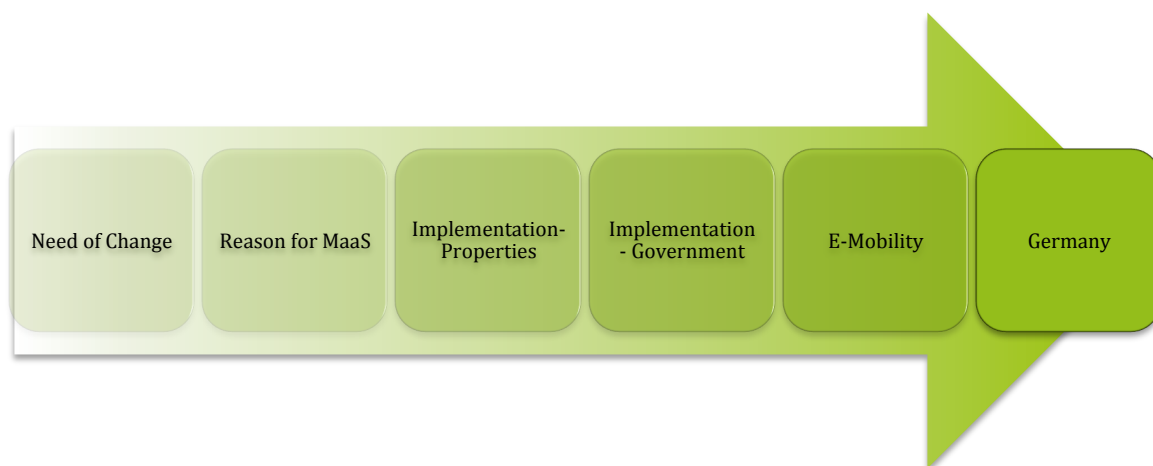
Figure 13 - Chapter overview

5.1 Introduction

The first category is "introduction", where mainly personal key facts about the interview partner, statements about the creation of MaaS and the personal first reaction about MaaS are included. Within the personal key facts, the interview partners talked about their personal job history (see Table 13) and what their current workplace is responsible for, as the following examples show.

My name is Jemina Uusitalo and I have been working as a MaaS project manager at HSL for one year. I am new to the sector actually, because previously I worked for ten years as a consultant...

Jemina Uusitalo [79]

My name is Noora Lähde and I am working as a chief advisor in Finnish Transport and Communications Agency. Actually, this is a new organisation, because we started at the first of January this year. We got together from Finnish Transport and Safety Agency and Finnish Regulatory. So we have a scope of transport and communications.

Noora Lähde [78]

Regarding the creation of the idea of MaaS, the interview partners agree that the idea of MaaS was conceived throughout discussions between private and public representatives around 2007 and 2008. A real push in recognition this topic was achieved through Sonja Heikkiläs's master thesis [80]. The importance of this collaboration will also be displayed in further categories. At this point, it can already be said that for new innovation, this collaboration is essential, as the following papers [81] & [82] and also Chapter 3.2 & 3.5 show. Here, for instance it was shown that the infrastructure for e-mobility must be mainly public or semi-public, so a satisfactory network for car fleets is available.

I think that the idea originally was born in the discussion between public and private sector. One of the previous ministers had a club for transport policy and that was one of those discussions where at some point the idea came up.

Laura Eiro [83]

I first noticed MaaS with the publication of Sonja Heikilää, who got international recognition.

Tommi Lampikoski [84]

Regarding the last point, all interview partners had a very positive reaction when they first got in touch with the idea of MaaS. The reasons for the positive reactions, on the other hand, were very different. For example, Mika Kulmala had a very logical and functional view of the advantages of MaaS.

It was totally different, because normally the mobility sector is quite traditional with buses and

taxis and it´s very regulated. It was a very new nice idea and you have to think in another way

of this whole mobility, that you can go from place A to place B, which is the best way to travel,

you only pay a monthly fee and you choose different kind of services.

Mika Kulmala [77]

Whereas Krista Huhtala-Jenks had an enthusiastic view on MaaS when it was not foreseeable which role MaaS could play.

The reaction was that this is really awesome. Obviously, it was not fully crystallized, like how

big of a point we were talking about at that point. We hadn't coined the term MaaS yet.

Krista Huhtala-Jenks [76]

One statement that has to be pointed out is the answer of Anne Berner regarding her first reaction to MaaS. She explained that when she became minister for Transportation and Communication in Finland, she didn't look back to the time when MaaS was invented. She rather wanted to get to know the idea of MaaS on her own. For that, she talked to colleagues, researchers and other experts in the mobility sector and said this:

In 2015 I had to learn and understand what MaaS exactly means. When I studied it, and I spoke

to colleagues from other countries, to researchers to the industry and to the start-ups, I tried

myself to make a picture of what MaaS means and what it needs.

Anne Berner [85]

This statement shows that it is necessary to visualize a new concept or idea and to get to know the advantages but also the disadvantages, based on which the decision can be made if it should be implemented or not (see Chapter 5.3)

5.2   Need of change

The next category is "Need of Change" and deals, as already mentioned, with the necessity to have a change in the current mobility and transportation sector. The following chart summarizes the statements of all interview partners and explains why a change in the mobility sector is inevitable.

current situation	Upcoming Challengas	Solution
- Inefficient usage of current mobility possibilities - overwhelmed service providers - difficult usage	- need of new infrastructure - reaching climate goals - mastering the future challenges	Putting the customer in the focus through MaaS → new business opportunities

Table 11 - Need of Change

As visible in Table 11 the main statements of the interview partner can be displayed in a process-diagram. The process first describes the current situation, where all interviewers mentioned the bad situation. The reason and most common statements mentioned were the inefficient and difficult usage of current mobility possibilities . Furthermore, it was mentioned that the current mobility system or service infrastructure is overwhelmed, as was also mentioned in the introduction.

Secondly, the upcoming challenges are putting even more pressure on the current system. The current system needs either more infrastructures or a change in the concept. Another point here is that Finland lacked budget for more infrastructure, which put even more pressure on finding new solutions. Laura Eiro said the following regarding this aspect:

You cannot just build more infrastructure all the time. You have to remember that 1/5 of the population is using cars. What happens when the rest starts using them? If all developing nations start using transport as we are doing at the moment, it's just not possible. It will globally explode and that is the case everywhere is a lack of public money to subsidise public transit.

Laura Eiro[83]

A further relevant point are the EU climate goals, which were mentioned by the majority of the experts and in previous Chapters. In combination with the challenges of urbanization, digitalization and individualization, the current mobility system is, according to the experts, unsustainable. A change of the current mobility system is inevitable and necessary.

I think the key issue is that transport sector is really a major source of greenhouse gas.

Tommi Lampikoski [84]

I think, what we, at the EU-Level, should see is that the change is quite inevitable.

Laura Eiro [83]

In their point of view a concept that uses the current transport possibilities in a more efficient way and also focuses on the needs of the customers, is needed. Therefore, a service orientation is necessary, where on the one hand the efficiency can be increased and on the other hand the challenges the population faces can be tackled simultaneously. Furthermore, the new concept can compete with other concepts that are coming from outside of the EU and that try to bring their business to the EU market.

All experts see MaaS as one solution that fulfils the mentioned requirements and can even bring new business opportunities and markets, which is a very important point for the implementation of e-mobility (see Chapter 3.4). A detailed view why MaaS is the right solution will be shown in the next Chapter.

5.3   Reason for MaaS

Previously, it was shown that a change in the way mobility and/or transportation are provided or consumed is needed. To explain why MaaS can be a solution, the experts started with a definition of the concepts. The main declaration is that MaaS combines the physical world (the infrastructure) and the digital world (the services) (see Figure 14).
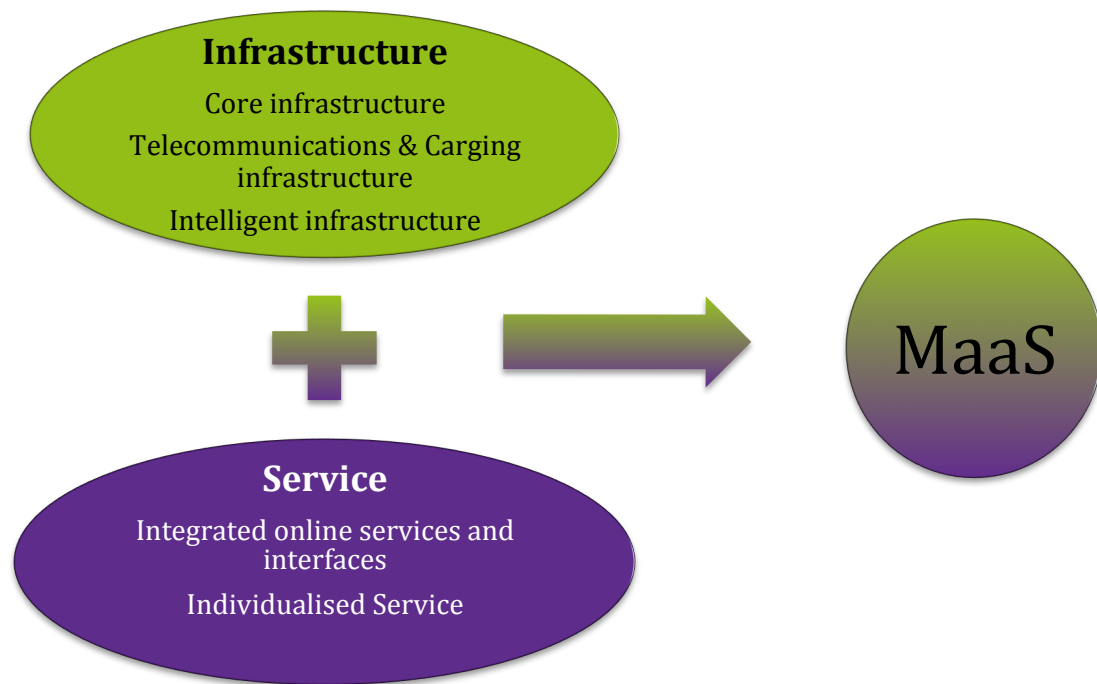
Figure 14 – Combination of Infrastructure and Service in the context of mobility

Figure 14 presents what the main statement of all experts is and shows which layers are all combined. One important point mentioned is that MaaS includes the current trends digitalization, attitude change and people behaviour, as Jemina Uusitalo and Noora Lähde describe in their statements.

I think there is a lot of thought in the concept or in the idea of MaaS and it incorporates the current trends and it takes in account the digitalization and a sort of attitude changes and how people behave. We are moving towards people wanting to have everything easy and not having to worry about it too much.

Jemina Uusitalo [79]

Actually [,] in the future [,] when the mobility is connected to everything [,] it´s not only about the mobility part, but life as a service.

Noora Lähde [78]

Especially Noora Lähde's statement shows that life and people's behaviour change. The service level in people's lives is increasing and must also be implemented into mobility. The increasing numbers of service providers, for example, in health care and food delivery [86] prove these statements.

Furthermore, an important aspect is that the mobility concept transforms from a profit or system optimization to user orientation, where customer service is the first priority. Based on this user-orientated ideology, decisions should be made. Regarding this, new and different services can be created to meet the needs of the customers and compete within the ecosystem (more detail in Chapter 5.4).

User orientation is something that I have lived with all my life as an entrepreneur. So that was something I felt is very right to turn service more towards the user instead of only looking after interest of the service providers and to the structures.

Anne Berner [85]

The most important point for all participants was the environmental benefit that MaaS can bring to the mobility sector. In addition, the climate goals are putting a lot of pressure on the government, so a change to a cleaner transport mode is necessary. MaaS provides this in the opinion of a majority of the experts and gives the consumer the opportunity to choose an easier way to move. Furthermore, the binding to a privately-owned car can be broken up and a real alternative to the car would be available, as Piia Karjalainen explains.

It is also bringing a lot of new options and alternatives for the users. I see that it is really giving freedom of choice, because in urban lifestyle people are often depending on the use of the car and what people like to provide with mobility as a service is to give an alternative for the car dependant lifestyle.

Piia Karjalainen [87]

All experts think that MaaS can have all these advantages and especially provide a value to decrease the environmental output of the mobility sector, but some of the experts also say that these benefits must be proven. Until this time, it is just a prediction that MaaS can bring a certain value. Furthermore, the scale of the effect has to be measured. All in all, the experts share the main understanding that MaaS brings a lot of potential that supports the customers' needs and masters the upcoming challenges.

In the following, it shall be shown that a change in the mobility sector is inevitable. Furthermore, the interviews and the literature underline that MaaS has the capability to bring the transport and mobility sector to the next level.

For the government and for me as well MaaS is lifting the transport system up to the transport system 2.0.

Laura Eiro [83]

Now, it is important to figure out how MaaS can be implemented and which conditions are necessary to have a possibility for MaaS.

5.4 Implementation – Properties

In this abstract, the required conditions according to the experts will be displayed. Here, it must be mentioned that not all statements of the condition can be delineated. The amount of statements was very high, which on the one hand underlines the importance of this Chapter, but on the other hand does not give the opportunity to discuss all requirements that were mentioned here. Due to this, just the most important and most-mentioned aspects will be put into context and discussed.

Firstly, most experts believe that MaaS is already around. The problem is seeing the connection between all the different providers. Also, the handling of all the physical services is not functional and difficult.

Basically [,] some people are saying that MaaS has always been there, because it´s already integrated. Maybe that is true but up until now, we were not able to see all the service.

Laura Eiro [83]

The following figure shows which requirements are necessary for an easily accessible, competitive and sustainable MaaS concept.
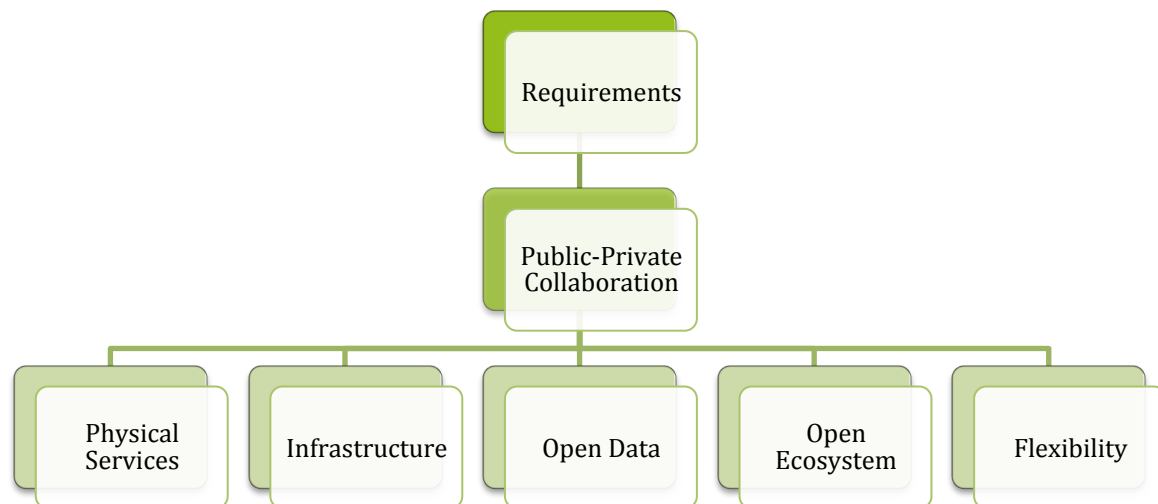
Figure 15 - Requirements for an adequate MaaS concept

Figure 15 compiles all statements in one graph to get a first overview of which main requirements or basement are necessary to build or implement MaaS. One important topic is the public–private collaboration. This will be part in the next Chapter, where the role of the government will be explained within the implementation cycle of MaaS. In this part, the main focus is on the tasks within this collaboration. Firstly, the people have to be educated, so an understanding about the current mobility system may be accrued.

Educating people, that they understand the current situation and understand that it's not as good as it might be and it´s not the way forward.

Laura Eiro [83]

Furthermore, it is important to understand people's mind-sets. As already mentioned in previous Chapters, the customer is the main focus and because of this, understanding how people process mobility and how they make decisions is very important. In addition to these two points, the awareness of MaaS has to be brought to people. On the one hand, the previously-mentioned misunderstanding about the current situation and, on the other hand, also the recognition that there is MaaS as a real option beside the privately-owned car.

What the city could also do is raise the awareness of these mobility services. It is still not that well known and not that well understood. So they should work together with the private companies on how to do that and show how the services work.

Tommi Lampikoski [84]

The second point that the public–private collaboration should focus on is the creation of new innovation and business opportunities. All experts explained that it is important to create a market in high-density areas. Even more important is the creation of business models, wherein also rural areas are included into the system of MaaS. Anne Berner describes it even more drastically:

We need solutions for the cities [,] and we need solutions for the long distances and countryside. For me actually MaaS is the solution for remote areas, if you don't do anything in these areas there is no services at all.

Anne Berner [85]

A further important point is the implementation of the digital world into the mobility concept. For some experts, this can also enable the market and push the awareness for MaaS. This can happen via digital implementation (the previously-mentioned aspect), for example education, where through application people can be taught the main idea of MaaS in an easy way. Especially the fast and easy access to information can be provided with digital solutions. However, even more important is the access to the different service providers, as already presented in Chapter 2. The following figure summarizes this for clarity.
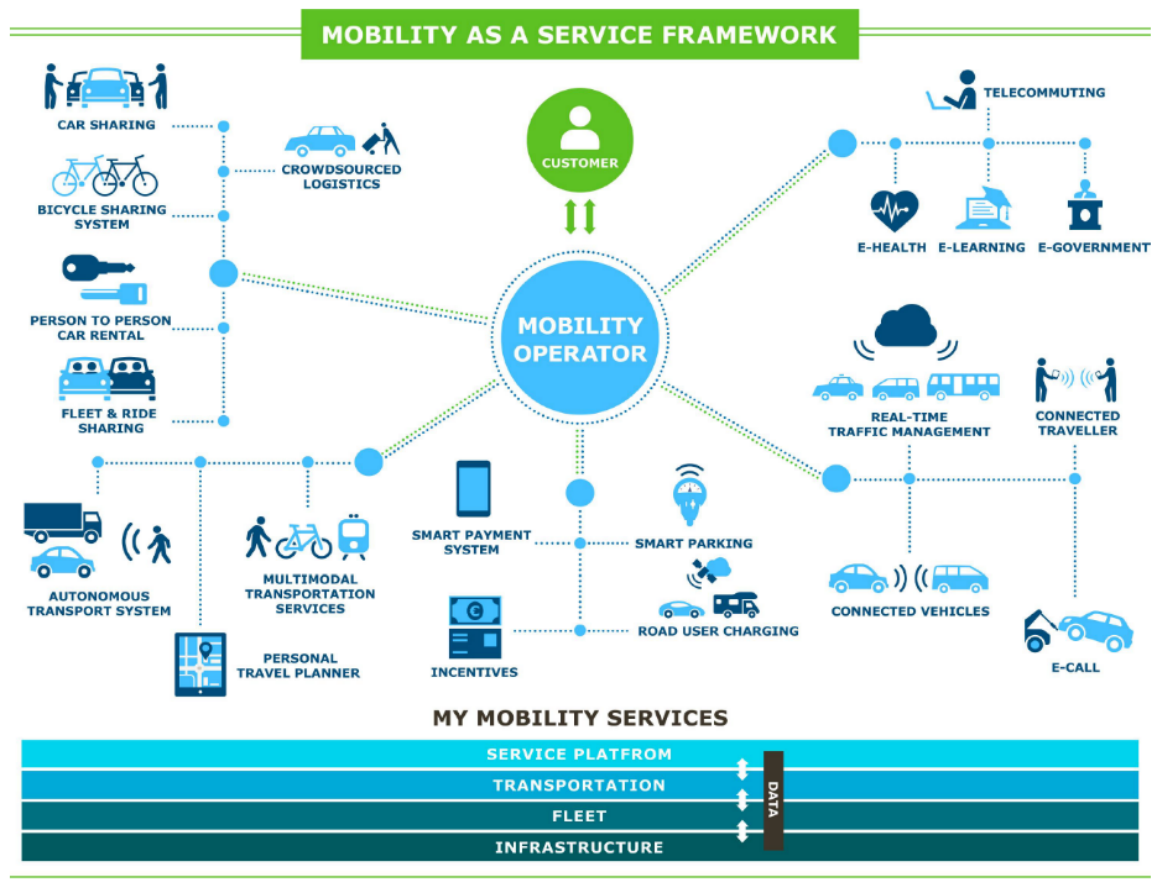
Figure 16 - Idea behind MaaS

Most important for the majority of the experts is that all participants that are shown in Figure 16 find a position within this new ecosystem. The current big players within the mobility sector see the high potential of the market but also the risk of losing their position as leaders.

Of course [,] if we add new layers and stakeholders to the mobility ecosystem [,] it might cause some obstacles for the existing players and that is of course something that we are aware of. If we are talking about providing an alternative for the car, ownership and usership [,] of course the car manufacturer would get in the spotlight then, but (…) we [all] have (…) big European car manufacturers as our member at Maas-Alliance, so they are really supporting the idea, because they have to change their business model, they have to change how they are providing services and products, but still they see that they want to be part of it. That means they see there are business opportunities.

Piia Karjalainen [87]

As common or main statement, all experts described that public transport will be the backbone of MaaS. One reason is the potential to transport a high amount of people at the same time, which again affects the environmental impact.

MaaS Service is not a good service if there is no public transport.

Mika Kulmala [77]

Regarding this topic, where every party has to find their position and a way to provide a satisfactory service, some experts explained that it is possible to run this whole system via one provider. To do this, they need many new innovations and more implementation time for new mobility options in their system. For example, a car manufacturer could provide car sharing, ridesharing and possibilities for bus transportation, but they would need to implement, for example, other options like trains, bikes and also develop an interface. For that, they need, on the one hand, expertise and, on the other hand, time. During this transformation, they could create a collaboration with other providers to fill these gaps until they can provide the rest of the service by themselves.

What is really a nice example of business strategies from MaaS is what (…) "De Lijn" is doing here in this region of Belgium. They call it hybrid strategy, meaning that they for sure plan to do MaaS themselves at some point, to be based on their services, but until they have a business and operational system to do it, they are still willing to collaborate and integrate their services with other MaaS Services and this is something which is a really [,] really [great] push for the development of the industry in Belgium.

Piia Karjalainen [87]

These three factors are, for the experts, the most important points to support MaaS and provide the further described requirements to build up MaaS. As visible in Figure 15, the requirements consist of five main factors, which are the physical service, the infrastructure, the legislation & regulation, an open ecosystem and flexibility within the whole system. They can be seen as pillars that hold the concept of MaaS up and, according to the experts, are necessary before MaaS can be implemented.

The physical service itself consists of the transport providers, who execute the service. For example, MaaS Global is currently not providing any physical service and depends on the actual transport providers, as Krista Huhtala-Jenks explains.

But what does MaaS looks like. It´s heavily depending on what physical services are there and it's not limited to personal transportation or for example on land transport, but it´s more all the different services as well as freight.

Krista Huhtala-Jenks [76]

One important statement about ridesharing was made by Tommi Lampikoski, which shows the difficulty and the complexity within this topic.

I think there is potential in ridesharing, but ride sharing with people you do not know is problematic. On the other hand, ridesharing with kind a like people you know from your neighbourhood or from workplace, would work a lot better.

Tommi Lampikoski [84]

Here he describes the problem with this concept. Ridesharing is often done with strange people and is unwanted in some cultures or areas. Again, the importance of different solutions is incontrovertible but it has to be adapted to people's wishes.

In combination with the physical service, the infrastructure is the second factor that was outlined by the experts. Figure 14 showed, in the previous Chapter, that infrastructure consists of three main points: the core infrastructure, the telecommunications and charging infrastructure and the intelligent infrastructure. The main point in this topic is, for the experts, that the usage of new and innovative technologies, like autonomous or electric vehicles, has to be implemented into the mobility sector. With MaaS, it is much easier, because new business models and new markets will be created, where the funding and trials can be taken in account. Furthermore, the new technologies bring even more efficiency and flexibility into the concept of MaaS.

It´s obvious that MaaS brings the efficiency through the modern technology [,] taking into account (…) [that] this works as an enabler.

Krista Huhtala-Jenks [76]

Another thing is, if you can't guarantee D2D mobility, it will be very hard to move masses of consumers. You really have to pick up the service level and automotive services will play a big role.

Tommi Lampikoski [84]

Another pillar regarding the requirements for implementing MaaS is the necessity for data access or, as many experts call it, the "open data". It is part of fundamental legislation changes in Finland. This is part of the next Chapter, where the role of the government in the implementation process will be analysed. In this abstract, it will just be shown which requirements are necessary according to the experts.

One point mentioned by almost all experts is that for a satisfactory MaaS system, the accessibility of data is indispensable. Krista Huhtala-Jenks for example explains the role of the accessibility to data this way:

If you are tapping into those big [,] big changes, you actually start connecting into a mobility mix and that is where we do massive shares. But here you have the biggest challenge and the biggest possibility. So how we make that whole complex more efficient? It's through data. If we have data running through all these different knots [,] it has the possibility to improve everything. The operations or the services and so on and get a whole lot closer to what the customer needs.

Krista Huhtala-Jenks [76]

As in this statement, visible data cannot just make the whole transport sector more efficient, but also fulfil the needs of the customers, which is the most important aspect for the experts (see Figure 15).

One important part of the data topic is the access to the APIs (application programming interface). Without the physical access to the platforms of the service providers, it may not even be possible to create a change in the mobility system.

With the open APIs, the real time availability and pricing will come to the transport system and that will then create a holistic possibility for the transport system.

Anne Berner [85]

You need that physical access. Especially through the APIs, through payment, if I can't sell you a ticket to a seat or something there's no difference.

Krista Huhtala Jenks [76]

Furthermore, it would be better for the system if service providers opened up their APIs voluntarily.

I would like to see that the companies see themselves that there is a benefit in MaaS and open up their APIs

Sonja Heikkilä [88]

Additionally to the open APIs, the possibility to buy tickets through a third party, like for example Whim as a MaaS operator, is necessary to make the whole system easier to use for the customer.

Opening data in standard modes, opening ticketing systems standard modes, so it´s easy to use these interfaces and all kind of services in one MaaS Application and Service.

Mika Kulmala [77]

Not just the customer would benefit a lot from opening their ticketing system, but also the service provider themselves would have the chance to receive a larger share of the transport sector.

So I heard a lot about train operators want to keep their system and sell their own tickets and don't give anything of it away. What we think is that if they want to have more customers, one way to do that is to give other operators to sell their tickets.

Saara Reinimäki [89]

The open data approach shows the important role of digitalization within this process and the access to data from different parties. The essential role of the access is undisputed, but as Sonja Heikkilä´s statement shows, it would be better if the service providers opened themselves rather than be forced by legislation changes (see in Chapter 5.5).

A further point in the Finnish procedure to implement MaaS is the open ecosystem approach. For the Finnish government and even the companies, the open ecosystem is the key to producing sustainable outcomes and improving the service level of each provider.

That particular thing is that we strongly believe in this open ecosystem approach. Even as a company. As well that if we do this open ecosystem way [,] then mobility as a service is able to fulfil those promises about sustainable outcomes and improve the service level of each provider.

Krista Huhtala Jenks [76]

The opening markets other point of view is that I think that there would be more options available [,] so the service level could increase on mobility services.

Saara Reinimäki [89]

These points already show the potential the Finnish government sees, but even more important is the result of the open ecosystem. Through all the improvements, the service providers would be forced to go through the competition; the customers would benefit the most.

You know we are living in a world of individuality and people want to have options. So that's where we are definitely going and how people want to consume these different options or which once they choose, that's the interesting part.

Jemina Uusitalo [79]

When it comes to the usefulness of the system to the user – Yes I think when it comes to the legislation it´s very hard … but when we think of the users of such an ecosystem it would be just wonderful to have more options and just use any service.

Sonja Heikkilä [88]

As already mentioned in previous Chapters, the whole system of mobility has to develop towards a user-centric system – just in this case the people or customers have the possibility to change their moving habits.

You kind of twist everything around the user and then put that all together and that brings us
the new way to organize mobility.

Sonja Heikkilä [88]

This statement also brings the next pillar of the requirements for a sufficient MaaS system. Flexibility is essential to get the customers to use the new system and replace the privately-owned car. The combination of already existing services is one part of the flexibility the customers need.

There have to be public transport, taxis, city bikes, and all kind of this in one service. Then it's a
service that people maybe use. Before that it's just a number of services and a number of Apps
and that's not good.

Mika Kulmala [77]

In reality, I think D2D Mobility is needed, so you can really start to move the masses and the
mobility players have to combine their services in a better way that could appeal better to the
consumers who own their own vehicle. I don't think they want to stay outside for too long in
the rain and snow.

Tommi Lampikoski [84]

These points are just a piece of the requirements that flexibility in this context has to fulfil. Further points are, for example, adapting to local and cultural conditions, real time services and cross boarder connections to make the system usable for the customer or consumer.

I think that transport is very local and you always have to adapt to the local conditions and the
local people.

Jemina Uusitalo [79]

As this Chapter showed, for instance in private and public collaboration, the open data approach and the open ecosystem, which is necessary, according to the Finnish experts. The involvement and the role of the government within this process are essential. This role and the tasks of the government will be displayed in the next Chapter.

5.5 Implementation – Government

Throughout all interviews in Finland, the main statement was that the government has a key role implementing a massive change in the mobility sector. In this Chapter, the role but especially the tasks the government has will be showcased. Furthermore, it will be shown in which parts there has to be interference and where it can be done without involvement of governmental changes.
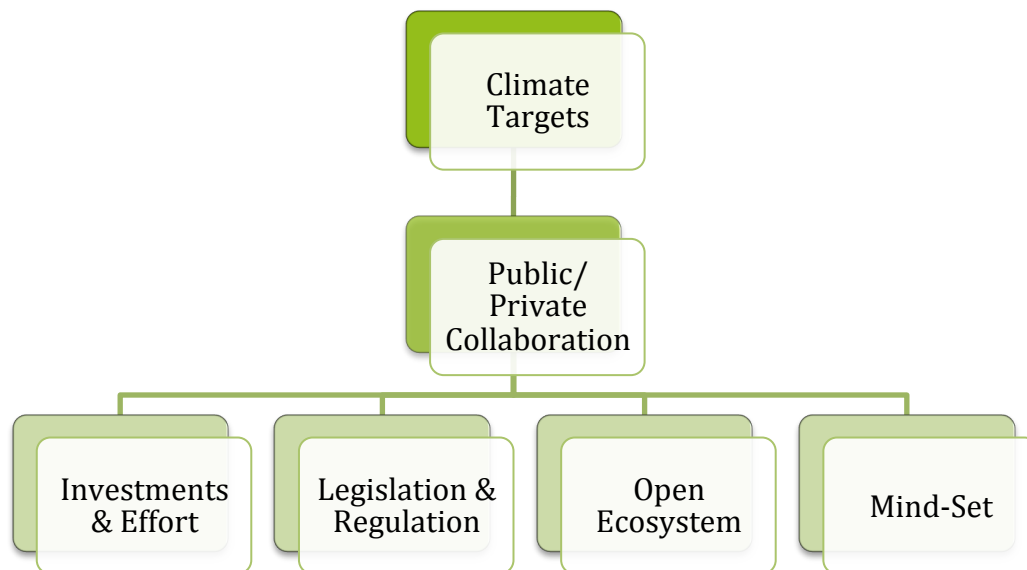
Figure 17 - Governmental role in the implementation process of MaaS

Figure 17 summarizes the most important statements of the experts and brings them into a connection and relationship with each other.

On top of all statements and the reason and necessity for a change in the mobility sector are the climate goals or the climate change that is already visible (see Chapter1 and 5.2).

Then it was basically private sector and us who had to play with the idea of MaaS or transportation. Certainly, we noticed that it is something we would like to encourage. From the policy perspective it made sense for us and it was adapted in our Long-term policy planning and it got quite quickly political support in Finland.

Piia Karjalainen [87]

So we want to be the forerunner for enabling this new Mobility services, so we are able to reach the climate targets.

Noora Lähde [78]

The starting point for the most experts is the collaboration between the public and the private sector. Of course, it is possible to force an ideal vision from the governmental perspective, but in collaboration, a vision of the new mobility concept can be created from which everything else develops. The most important part is that the private sector feels as part of the development and the necessities from their perspective can be implemented.

So you have to involve all stakeholders in the preparation and that's what we did and still been doing very closely. [...] we really used a lot of time to sort of create a common understanding about what needs to be done and try to address the concerns.

Laura Eiro [83]

We had a good preparation and transparent exchange with the companies. We had a lot – we called them – round table discussions during the preparation of the law.

Anne Berner [85]

Within this collaboration it was not just important to create a vision or common understanding of MaaS, it was also important to define the role of each participant, enforce new innovations through easier access to pilot projects and operative involvement of the government to be, for example, the first customer of the new system or help to build up the infrastructure.

So the public sector collected different players and organisations to come together and discuss what MaaS is and what does it mean to your business and your organisation and how should you react in terms of achieving the vision of MaaS. [...]. Further, the public sector funded the first pilots and businesses here in Finland and so they initiated the first projects.

Sonja Heikkilä [88]

So the environment and atmosphere to encourage new kind of thinking […] , that we don't have
so much bureaucratic for example when you want to start a test for automated vehicles you
need a test permit everywhere, but we made it as less bureaucratic as possible.

Noora Lähde [78]

In the statements, it becomes very clear that the government first wanted to collaborate with all the participants of the mobility sector. Even more important was the personal interest, participation and commitment of minister Anne Berner herself. Through her own commitment, every other participant in this process felt the importance of this change.

The minister had a lot of them and assisted and that helped a lot. She took a lot of personal
interested in it and I don't think it could have been this successful, because she showed that she
is committed and then everyone else wanted to commit.

Saara Reinimäki [89]

Out of this collaboration, the government or the Ministry for Transport and Communication developed a strategy paper to enable and enforce MaaS. This plan is called National Growth Program.

Later the ministry of transport and especially Krista Huhtala-Jenks was one of the experts in
MaaS and pushing that thinking through in the ministry. And she was part of the project where
I was one of the key facilitators of Finland's transport growth program 2018 – 2022,[…] were
also recommendations were implemented, what should be done to push MaaS forward.
Tommi Lampikoski [84]

Throughout this collaboration, the following pillars or actions were developed, which are also visible in Figure 17. The first part are the investments and the personal effort to develop this new mobility concept. The personal effort was already seen in the previous statement by Tommi Lampikoski. The personal effort stays on the one side, but public monetary investments on the other side were or are not intended, as Anne Berner clarifies.

If you think that we are pumping money in this system – No! I think the money needs to come
from the private side.

Anne Berner [85]

It is more about enabling and giving the private sector the perfect conditions to create MaaS and support the business through public procurement and create possibilities to export these new innovations.

It does matter how the procurement are be done. If you are using the innovative procurement, models and then we have to help the companies to create export and internationalise.

Laura Eiro [83]

A further fudamental topic – and the reason for the Finnish experts why the development of MaaS is so quick in Finland – are the legislation changes or interventions. It is the basis for enabling and supporting the new concept, as previous mentioned. The Finnish government saw the necessity for adapting the law to the current trends. One very important point were also the changes in the structure of the ministry itself.

First, we did a change in the ministry's organisation. We reorganised the whole ministry and we said in our communications, digitalisation and transport are more integrating, that means that we have to also make sure that we integrate our legislation and so the ministry was reorganised.

Anne Berner [85]

So, one point is the adaptation of the government itself to the new challenges and another point were the legislation changes themselves. An important part within these changes were the opening of data, API and the ticketing system. It was already shown in the previous Chapter that they are essential for a sufficient MaaS.

The legislation is the first. If it´s not the case that companies and authorities have to open all data and ticketing systems [,] it´s difficult to make good MaaS Services. There could be services , but there's [a] number of services. Not services that include different kinds of travel possibilities.

Mika Kulmala [77]

During the legislation process, there were almost no problems with all participants. The only problems were with the taxi industry and the governmental railroad company, as Anne Berner explains.

I don't think that was the point, but the taxi industry was reluctant to give up the protection that they had from the government. The government was securing the price and regulating it. The governmental railroad company thinks, that their tickets can only be sold by themselves and things like that and no opening data, but they are complying now. That was the only sort of struggle we had, but otherwise it was fine.

Anne Berner [85]

This inside information from the minister for Transport and Communication shows that changes within an ecosystem like the mobility ecosystem are never without resistance, but the focus has to be on the people and the majority of the ecosystem. Therefore, the government in Finland decided to intervene. The further statement of Anne Berner shows that the government really believed in this new concept and also had no fear of confrontation, for example, with the taxi industry during the legislation changes in the parliament.

So either they are out of it – of the whole MaaS – or they are in.

Anne Berner [85]

Within the implementation process, an additional important aspect regarding the Finnish experts is the liberalisation of the whole transport market.

You have to liberalise and open it in order to reregulate it over data.

Anne Berner [85]

Liberalisation means, in this context, to open each transport sector, as for example the railway market, to have competition. This point was and still is one pillar within the implementation process in Finland. It does not mean, as Krista Huhtala-Jenks said, that there should be an uncoordinated and unregulated transport sector, but as Anne Berner explained in the previous statement explained:

Now that doesn't mean that we have that wild [,] wild west[...].

Krista Huhtala-Jenks [76]

Maybe I want to emphasize that I don't want opening up markets [,] means [a] completely unregulated market or a wild west type of market. We still need to have strong public parties that regulated that the competition is fair and the playing field is level.

Saara Reinimäki [89]

The regulation shall be adapted to the current conditions and trends, where especially the digitalization has a great impact on the mobility sector [90]. Throughout the opening of the market, the Finnish government intended to create new business potentials, increase the service level and eliminate possible monopolies in certain markets.

It's important to have good start ups or old companies coming up with new innovative business models and service types in Finland an even export them outside of Finland.[...] The opening markets other point of view is that I think there would be more options available so the service level could increase on mobility services.[...] They should be able to benefit from that availability of services. So they won't have only one operator that they have to buy those services from.

Saara Reinimäki [89]

One of the most important statements is the mind-set of the government. It is essential that the government understands the necessity for a change and wants to reach or influence the transformation process.

We were really the first ones in the world starting to change the mind-set around the policy and the regulation and that is not an easy thing to do. It seems kind of self-evident at the moment, but when I for example started in the transport sector [,] it was like everybody was talking about infrastructure and how to fund it and anything beyond that was nonsense.

Krista Huhtala-Jenks [76]

This statement by Krista Huhtala-Jenks shows that the change from an infrastructure-guided development to a service-orientated development was and is

the key. On the one hand, it makes mobility more efficient and, on the other hand, it considers the lack of capital that Finland had at this time.

There were infrastructural plans, which were constantly pending, because of the budget. We just didn't have the budget to make them realised.

Piia Karialainen [87]

Nevertheless, the most important step was to realise that the previous structures within the government itself were not able to make this change happen.

First, we did a change in the ministry's organisation. We reorganised the whole ministry and we said in our communications, digitalisation and transport are more integrating, that means that we have to also make sure that we integrate our legislation and so the ministry was reorganised.

Anne Berner [85]

Further, it was important to support the development of innovative transport modes or new kind of business models and not to restrict them with a huge amount of bureaucratic work. To enforce this and speed the development up, a special agency called Traficom was installed.

We also want to create an atmosphere to encourage new ways of thinking. Furthermore, the collaboration between private and public is a big point. To enable this [,] we want as less bureaucratic as possible, so you can test your experiments as fast as possible.

Noora Lähde [78]

Within the change of the mind-set, an additional point is the change from supporting certain transport providers, like the public transport or the automobile industry, towards a user-centric system. Therefore, the previously-mentioned encouragement to create new innovative products and business models is led in the right direction, through collaboration between the private and the public sectors.

I like to think that MaaS is a lot about the mind-set, where the user is first and starts from there.

Sonja Heikkilä [88]

In this Chapter, it is clear that for a humongous change within an important sector, such as transport and mobility, the partnership and cooperation of the private and public sectors is essential.

5.6 Satisfaction

The requirements and the essential changes were described, but when the mobility sector changes are so fundamental and claim to be user-orientated, the people's opinion or satisfaction are the most important assessments to be made. By virtue of the system's youth, which has been operating in Finland since the beginning of 2018, a reliable evaluation is not possible. The experts mentioned this several times, but on the other hand gave an overview of the first year.

The first mentionable part is that some people are always against new things in the first place and a change is never executable without resistance.

Of course, there are some people who in Finland say that it is nonsense and it will never happen. So the same goes everywhere.

Laura Eiro [83]

On the other hand, Anne Berner tries to explain, using an analogy to the phone market, that it's questionable to restrict something when both options would be available. So, the people who want to utilize the new system or technology can use the new one; the others can still use the old system.

It´s very [,] very rare that at the same time you take away the analogue. It´s an addition and so why oppose a new technology [?] We still have analogue phones here in this country. So if you still want to make your phone call on a traditional phone – you can. But why would you prohibit everyone else to use the smartphone [?]

Anne Berner [85]

Furthermore, the first data and surveys of MaaS Global, which is the operator of Whim, shows that people of different ages use the application. In combination with the statement of Laura Eiro, it also shows the overall satisfaction the pioneers or first users have with MaaS.

Again, the studies or surveys for example MaaS Global has made with their customers, who have chosen to use, are actually very happy with them. They have bright variety of age groups from 20 to 65-year-old people and not just young people, as many predict. People who try are usually very happy.

Laura Eiro [83]
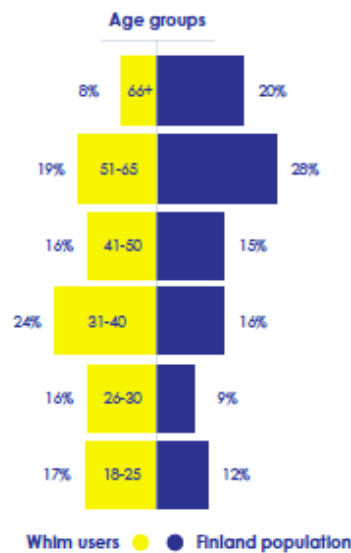
Figure 18 - Demographic table of utilisation of Whim [91]

For further expansion, the development has to continue, so people start trusting more. Especially the number, quality and, most importantly, the reliability of physical services have to increase.

There is still plenty room for development and that's what we try to do constantly to improve our service. […]We don't provide any physical services by ourselves, which makes us very depending on what our partner's physical services are like, but we also want to feed them with as much data and information as possible to improve their service, because that will improve our services.

Krista Huhtala-Jenks [76]

All in all, the first steps towards a sufficient MaaS system are taken in Finland. By using the new system and giving feedback, the customer can have a say in the further development of the new concept.

5.7   E-Mobility

The combination of the already discussed topics show that the implementation of MaaS can, on the one hand, provide a better service level for the user and, on the other hand, more efficiency. But, as mentioned in the beginning of this paper, the climate goals that each country in the EU wants to reach are very lofty. So just a change in the concept of how people use mobility is not the solution. A further possibility to increase the emission reduction is a change from conventional engine vehicles or transport possibilities to alternative options, like biofuel, hydrogen or electricity-powered transport options [92]. E-mobility is, as already mentioned in previous Chapters, the option with the most potential. However, on the other hand, people in particular have concerns at the moment, like the charging infrastructure, the affordability and especially the risk-free usage. One solution to give the people the opportunity to have a smooth entrance to e-mobility and particularly e-vehicles is the implementation through the MaaS Service Provider.
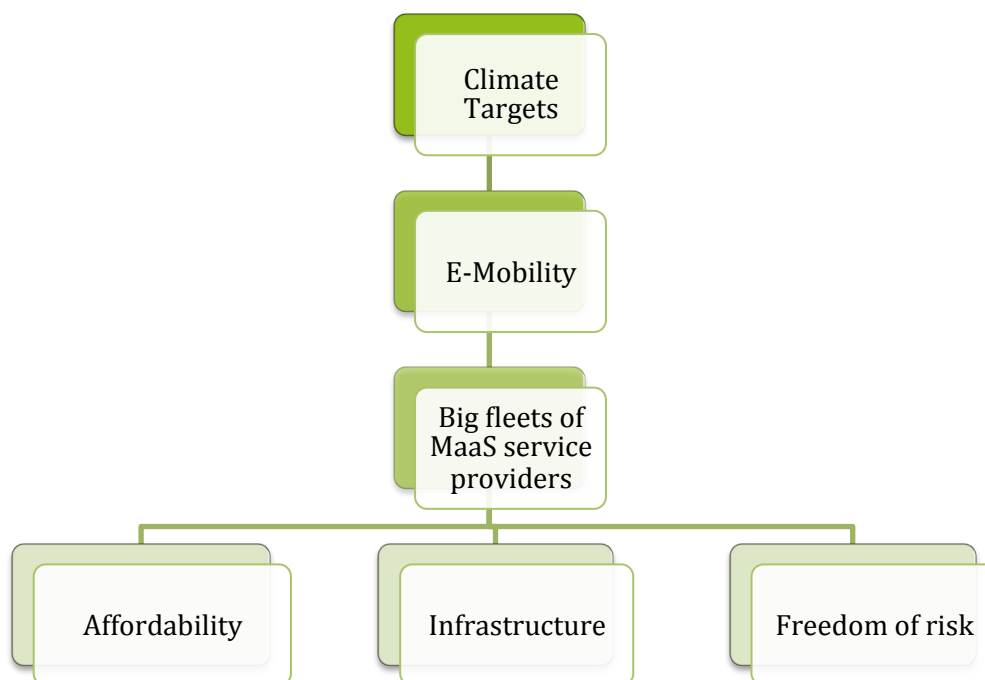
Figure 19 - Implementation of e-mobility

Figure 19 shows how the Finnish experts see a way to implement e-mobility and to get closer to the goal of reaching the climate goals. The advantage of e-mobility against the other alternative is the diversity of transport opportunities.

In order to unlock the whole environmental potential of MaaS, e-mobility will be used and all these MaaS providers of fleets would use e-mobility, [...] because public transportation is not comprehending enough services for the end-users, but when you get public transportation and different new mobility services – car sharing, ride-sharing, E-Scooters/Bikes, Bike-sharing, whatever – then we are able to provide comprehensive services.

Piia Karjalainen [87]

The potential is undisputable, but people's concerns are still there. In combination with MaaS, these can be eliminated, as well. The first two points are the affordability of e-vehicles in particular and their risk-free usage.

You have to make it risk-free, like moneywise but also regarding the use of e-mobility. Mobility is something that we need to get to the point we want. I guess risk-free is the most important point when talking about e-mobility.

Sonja Heikkilä [88]

A further topic is the charging infrastructure, which currently insufficient. So here it is clear that e-mobility has a great potential but still has to solve concerns. In combination with MaaS, these concerns could be solved, because large service providers would take care of all three mentioned problems, as, for example, OP is providing their customers.

In our service, for example we include to pick you up if you run out of battery.

Sonja Heikkilä [88]

Summarized, the potential of e-mobility is undisputable and many problems could be solved if e-mobility would be implemented in combination with MaaS, but for that, a sufficient infrastructure and enough provider must be available.

5.8 Germany

At the end of the interviews, the experts were asked how they see the potential of MaaS in Germany.

Germany is a massive market and has a lot of potential in the sense of that there are a lot of private Vehicles.

Krista Huhtala-Jenks [76]

Most experts didn't want to speculate, but the main statements were positive. The first point is that Germany has a much higher population as Finland, which makes it easier for the MaaS providers to build up a service-based transport mode.

You have a much bigger population, which would make it much easier to take it up.

Laura Eiro [83]

The role of the strong automobile industry, as the experts describe, is seen ambiguously. On the one side, the attachment to cars is very high in a car-manufacturer-nation such as Germany.

Maybe what might be an issue that as a private car nation there might be the mental part.

Laura Eiro [83]

Nevertheless, on the other hand, the car manufacturers can extend their business from the traditional role of a manufacturer to a much wider field with services included.

There are really great indications into that direction, so there are many orients for new service branches in orients beyond their traditional role as manufacturer.

Piia Karjalainen [87]

These new business fields are exactly what the mobility or transport providers in Germany see, as Piia Karjalainen from MaaS Alliance describes.

What we have as our members from Germany in MaaS Alliance, we have Hamburger Hochbahn as a public service provider from city of Hamburg. Then we have PTB as strong in transport modelling. Movel, which is part of this BMW and Daimler merge, providing new mobility services and Deutsche Bahn.

Piia Karjalainen

All in all, this whole Chapter (Results of the Interviews: Finland) showed the view of the Finnish experts in the mobility sector about MaaS. It became clear that a change in the mobility sector is inevitable, as well as the reasons why MaaS provides the

best conditions for the current trends und problems. In the following, it will explained which conditions have to be provided to build up an adequate MaaS system and which role the government plays in the whole process. Furthermore, the possibilities and opportunities to implement e-mobility are described and explained. In the end, the experts assumed that the conditions in Germany are even more promising for a successful and rentable MaaS ecosystem, as in Finland.
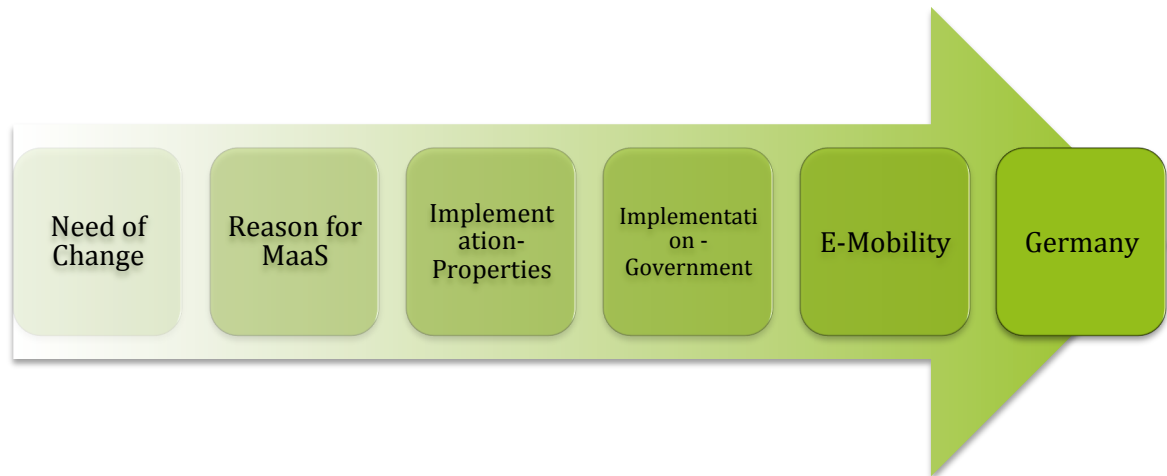
Figure 20 - Chapter overview

6   Results of the interviews: Germany

In the previous Chapter, it was shown how an implementation of e-mobility within MaaS can be processed. To create a roadmap for Germany, it is important to get information about the current situation and the future plans of the government, but also from the industry. Most important in this part is to get an overview about future plans in the mobility sector and also about the knowledge of MaaS.

6.1   Introduction

The introduction was the first part of the interviews. This part was meant to get a brief overview of the expert and the main focus of their work.

My concrete topics, which I work on here, are software development for automobiles also in the direction of aviation and drones, but mainly in the automotive sector and also development tools to be able to develop more complex software. Another big topic is "Internet of things" for automobiles.

Carsten Wolff [93]

This Statement by Carsten Wolff already showed in which direction the focus of the interview will go and how the questions should be placed. Furthermore, the introduction serves to get a first longer talking part, so, on the one hand, the ice between interviewer and expert can be broken and, on the other hand, the type of expert can be identified (see Chapter 4). Furthermore, it is possible to build up an atmosphere where the expert feels good and likes to spread information.

6.2   Need of change

In the first main part, the chief topic is to identify why Germany needs a change within its mobility concept. The statements will be summarized and put together, so they build a picture, which helps to understand the high amount of statements. The reason or necessity to implement changes within the mobility sector focuses on four main topics, as Figure 21 shows.
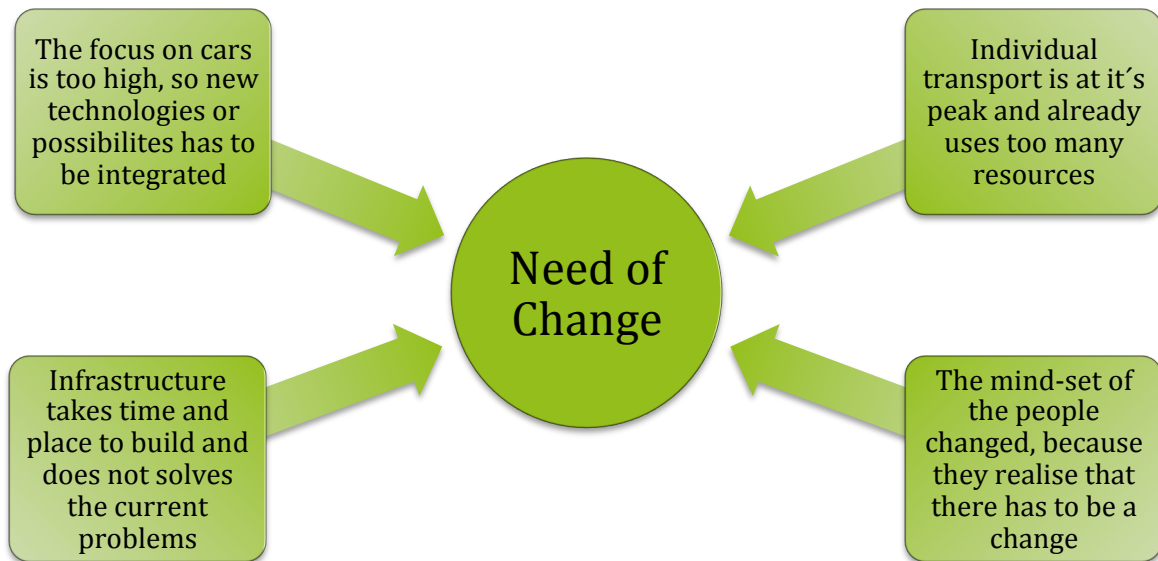
Figure 21 – German experts on why a change is necessary

The first point is that, for the current mobility concept, new infrastructure is necessary. New infrastructure takes not just time but also place to build, which is rare especially in cities. The experts showed that this way does not solve the current problems and can't be implemented, even more so when urbanisation will continue as quickly as predicted (see the Introduction).

So what we have analysed is that in a way we are reaching the limits of existing transport and mobility services. On the one hand, we have forecasts from federal traffic planning or local traffic forecasts that we can assume that traffic will continue to grow. At the same time, we have the situation that it is becoming increasingly difficult to create new infrastructures to cope with these traffic volumes. So in cities we often have the situation that we no longer have the space to create new infrastructures and in other areas we have the problem that first of all the social resistance against the new construction of infrastructures becomes stronger and stronger.

Jens Petershöfer [94]

The next point is the change from individual transport, especially the individual transport by car to mass transportation and connected transportation, by using new technologies and options.

What has been done in the past is that these other means of transport have always had to be put back and have not been able to develop adequately and now there is a need to catch up. That is one part.

Hartmut Reupke [95]

Yes, there are several trends that play a role there. Let's say, of course, the retrospective, that what we've done so far, like individuality and individual mobility with a combustion engine, has reached the end of it´s possibilities. There we see an overload of road traffic but also of rail traffic on the edge of it´s possibilities and air traffic as well. There [,] we need new solutions [,] and the problem of uncoordinated individual traffic is that there are inefficiencies with empty journeys and there are times when traffic management works badly.

Carsten Wolff [93]

In connection to this point is the next statement, where the individual transport mode causes too much resource consumption, which is an important problem for cities in particular.

Let me get started like this. It has become clear that in recent years traffic has been far too one-sided for a city worth living in and for a design of our environment worth living in. To a very energy-using and CO2-emitting industry and the automotive industry. It is now very clear that other incentives must be set there. We must give greater support to the move away from cars towards other modes of transport.

Hartmut Reupke [95]

The last point within this category is the change in people's mind-sets. People realise that the need for a change is indispensable, because they see in their everyday lives the reached limit of the current mobility concept.

At the same time, there is this feeling with people, because they are standing in a traffic jam every day and know that it cannot go on like this any longer.

Jens Petershöfer [94]

Furthermore, people have changed their view on mobility. Today, it is not important to have a car, which was a symbol of freedom in the 1990s, but it is now important to move from point A to point B.

[...]the behaviour of people is crucial. Nowadays it is said that people don't want to buy a car anymore, they want to buy mobility. In Germany, the car in particular still had a significance as a status symbol, as a symbol of freedom and what people want to own well into the 1990s. That is now gradually disappearing [,] and people only want to get from A to B.

Carsten Wolff [93]

6.3 Reason for MaaS

The ground floor for the development of a new mobility concept is the previous Chapter, where arguments for a change were displayed. In this part, the reason for MaaS as a new concept will be identified and brought in correlation, as Figure 22 shows.

Need of Change
- Urbanization
- Infrastructure is already overwhelmed
- Climate targets
- Change in the mind-set of the people

Demands for a new mobility concept
- Need of more efficiency
- Having free choice to choose the transport mode
- Developing the transport along the current trends of digitalization
- Creating new business models

Reason for MaaS
- Finish experts describe MaaS as the demands require
- Literature showed the possibility of MaaS to fulfil the demands

Figure 22 - Reason for MaaS

The requirements for the new concept were clearly identified. The first point is the demand to use the current infrastructure and possibilities in a more efficient way.

That is why we have said that we must live with what we have and try to use these infrastructures more efficiently.

Jens Petershöfer [94]

Therefore, it is very important to give the people or the customer a free choice to select between the different transport modes.

If I don't use that, it's gonna degenerate and lose value, and I don't get any of it. At the moment [,] when I can make people the offer that they do not have to choose a means of transport and [,] therefore [,] have to make a very big investment decision[,] and I can tell them that with an app or a certain tariff or service [,] they are able to satisfy their own mobility wishes and these from a variety of offers. Then that would be a completely different way of accessing users.

Hartmut Reupke [95]

Important in this context is that current megatrends, for example digitalization, are implemented in the new mobility concept. In addition, it should give companies the possibility to create new business models.

[...] that more and more people in start-up areas realize what can be done with data and [,] because mobility and data are closely linked, a lot happens in this sector. Many business models are being developed, [...].

Hartmut Reupke [95]

These requirements or arguments the experts in Germany point out are exactly the same as the Finnish experts and also the literature review of MaaS (see Chapter 2) described while explaining MaaS (see Chapter 5.4).

6.4 Implementation – Properties

Until this point, the analysis of the interviews shows that, on the one hand, changes within the mobility sector are indispensable (6.2) and, on the other hand, that MaaS is one of the most auspicious concepts that reflects not just the requirements of the experts but also correlates with the trends of the current time (see 5.4).

Within this Chapter, the most important properties, which were mentioned by the experts during the interviews, will be delineated. The first figure shows where the focus of the new mobility concept should be, what is necessary to do this change but also what must be put in focus beside the transportation of people.
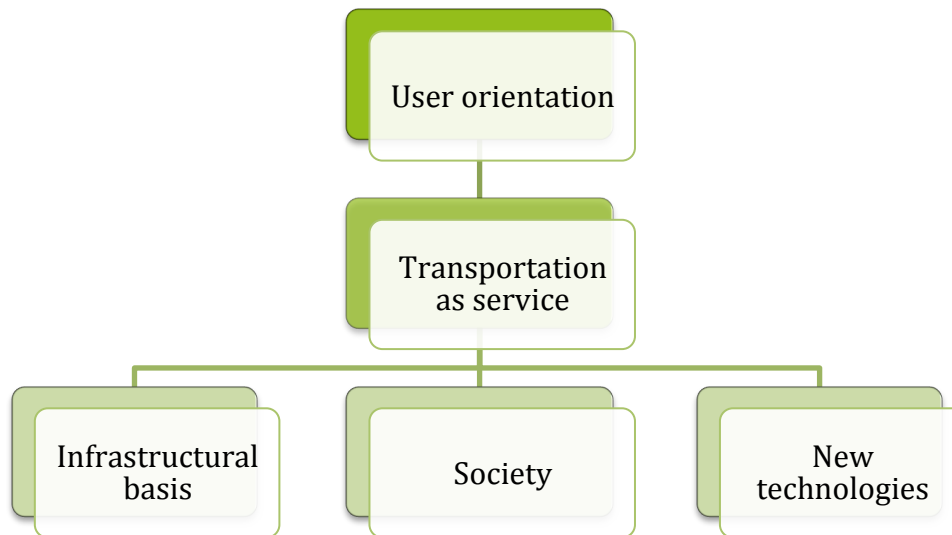
Figure 23 – User orientation as main point for further development

According to the experts, the change within the mobility sector should be the point of view on mobility. The user itself should be in the focus and be the main driver for further developments.

The aim should be to make it easier for users to choose freely between the different offers in the future.

Hartmut Reupke [95]

The keyword here is user orientation. Orientation toward customer needs.

Jens Petershöfer [94]

As these statements show that the people who use the transport sector should be in the middle of further developments, so the free choice between different mobility modes can be guaranteed. From this point of view, four major aspects were in the centre of interest for the experts.

From this point of view, it is necessary to change the paradigm from a asset driven mobility sector to a service-driven mobility sector. The main factor is the switch from owning a private car to purchasing a service for the individual transport needs without losing the convenience.

Mobility is no longer tied to the possession of a good, but a service. In other words, it is independent of an existing physical good. I use mobility as a service and I have a need for mobility and there are providers who satisfy this need for mobility. So a complete paradigm shift to what prevailed in the past.

Jens Petershöfer [94]

To execute such a change, three main pillars are mentioned. The first is the infrastructural basis, which is very important in the view of the experts. One aspect is the mobile network, so services can be purchased at each time and at any place in Germany.

That above all also an infrastructure is present which deserves this name and does not have developing country character. The keyword mobile network and coverage is catastrophic and embarrassing for an industrial country like Germany.

Michael Kuhn [96]

Within this statement, it is already visible that this point is not that of someone worried. The next point within the infrastructural basis is public transport. For the experts, a good public transport is essential for a service-orientated mobility concept and is even the backbone for this change.

At the same time, on the one hand we are the subsidiary of two automobile manufacturers, but on the other hand local public transport is at the centre of urban mobility.

Michael Kuhn [96]

The last point is the intelligent combination of the already existing mobility possibilities, so the previously-mentioned point of replacing the private car can be achieved.

The ultimate goal is to make more efficient use of our existing infrastructure. We have two paths to follow. On the one hand [,] the area of networking which we want to strengthen significantly, where it is also about exactly what I have presented to you. On the other hand [,] the whole is to be connected still with a prognosis possibility.

Jens Petershöfer [94]

An additional point here is the last mile problem[5], which is often mentioned when using public transport. One solution is micro mobility, where for example s-scooters are implemented.

So one form of E-Mobility that is also gaining momentum in Germany at the moment is that I have such a scooter with me and I use it quite traditionally with public transport. With the scooter, it would be much more practical for me, because the way there and the way from the stop I can now also arrange. So I combine mass transport, like public transport, with an individualised component and am therefore much more efficient.

Carsten Wolff [93]

Already it is visible here that the mentioned properties or requirements for the new transport mode describe the ideology of MaaS.

The next aspect, which encourages MaaS, is the technological development. As can be extracted from the previous statement by Carsten Wolff, micro-mobility is one fundamental part to implement the new transport concept. One point is the possibility to execute pilot projects for new transport modes. Another point is the usage of smart payments, ticketing systems and the aggregation of data on mobility offers.

Simplification of the payment process, but also aggregation of data on mobility offers and improvement of real-time information on available mobility offers. All this will then be combined with a forecasting option.

Jens Petershöfer [94]

The last point, which is mentionable, are the safety standards. For some experts, it is very important that new technologies fulfil the safety requirements.: regarding the data safety but also the physical safety.

Then [,] Data security is, due to strong digitization, and issue. Who gets which data and how is it ensured that the systems don't get hacked.

Carsten Wolff [93]

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[5] The Last-Mile-Problem is in this context for example the way from the bus station to the destination, which is often within a mile. [97]

In the case of the new constitution for very small electric vehicles, we initially opposed it from the Federal Ministry of Transport because we do not yet see a liberal opening, but a much stricter framework is needed. The danger that goes along with this is much greater than the chance we see at the moment.

Hartmut Reupke [95]

A further pillar for implementing a new mobility concept is the society. On the one hand, it is shown that the new concept should focus on the needs of the users, but on the other hand, the experts also describe that some people focus on other problems than the transport mode.

It should also not be underestimated that certain groups of the population simply have other concerns than sustainability. If I don't have a job or don't know how to get to the end of the month with my money, then [...] if I tell these people to buy the organic vegetables then I have to be careful that they don't hit me on the nose because they simply have other worries.

Carsten Wolff [93]

A further point in this context is also the ability to use that kind of mobility mode, where smartphones, the usage of applications and smart payment and ticketing systems are required.

However, these are also much further in terms of the use of smartphones and electronic payment methods. Germany is perhaps a bit more conservative in some areas.

Hartmut Reupke [95]

All in all, at this point, it can definitely be said that MaaS reflects the described requirements. Important is here to mention the change from the transport-mode-focused mobility concept to a user- and service-orientated transport concept. Furthermore, the new concept will be based on the public transport in combination with new players, especially in the micro-mobility sector. On the other hand, other societal problems shouldn't be forgotten and put into account.

6.5   Implementation – Government

As shown in the previous Chapter, the mobility sector or the way of moving people would change dramatically. Therefore, the next section will show which role the government should play in this process. Figure 24 summarizes the process, which the experts in Germany describe.

Public/Private collaboration
- Creation of a common new concept of mobility
- Creating infrastructure plans
- Creation of political framework

Political framework
- Enableing and supporting new innovations
- Beeing a role model for people and companies
- Education of people and companies
- Implement not just environment as decision factor
- Demand city cooperation and public transport
- Building a data saftey framework
- Encourage smart payment and ticketing

Current problems
- Overregulating
- Power demonstration by big players
- Structure within the government

Figure 24 - Governmental involvement in mobility change process

The most important part and the basis for any further development is the cooperation between the public and the private sector.

We want to develop key points together with market players, associations and interested parties, which should now be regulated in such a mobility law, how to set the framework and what is relevant.

Hartmut Reupke [95]

Essential is to create a common understanding of the future mobility concept, which implies for example infrastructure investments and the political framework. The

political framework is the key instrument for governments to lead all participants within the mobility sector in the same direction.

We want to work out together with the actors, which main topics we see and of course the topic "MaaS" is a very important topic in the area of new mobility. The whole area of sharing and pooling is very important, but also the question of what happens with the data and how anyone can support the topic of traffic control and traffic management more strongly out of the municipal responsibility.

Hartmut Reupke [95]

Therefore, the political framework, which would be created in cooperation with all participants, where private companies, the government, cities but also the people or customers themselves have a vote, is essential for governmental work. Components of this political frame are visible in Figure 24, but the most important parts, according to the interviews of the experts, is the support of new innovations.

I simply believe that you create a framework that does not hinder innovation but rather empowers and promotes it.

Michael Kuhn [96]

The reason is, on the one hand, the possibility to solve the last mile problem with new ways of mobility, like e-scooters or pedicels. On the other hand, the climate goals and decarbonisation of especially urban areas can be achieved.

An important component is also to promote decarbonisation in cities.

Hartmut Reupke [95]

Furthermore, the government hast to encourage the cooperation between public transport providers to create a consistent ticketing and payment system to lower the usage barriers for the customer.

We simply have to work on the transport regulations, but that can only be resolved at the level of the transport undertaking, which will in fact also be resolved if we have uniform tariff systems and booking systems.

Jens Petershöfer [94]

Lastly, the data provision and safety for smart payment and ticketing systems is essential for a new mobility concept.

Another point is the accounting systems. Here, too, I have a lot of points I have to pay attention to, such as the data security of the payment systems I use, when I say now that I want such a simple ticketing system. Then I have to regulate all these things.

Carsten Wolff [93]

The described points are just the most important parts, which were mentioned during the interviews. The problem with all these points is that the transport system in Germany is very heterogeneous and the satisfaction of each player and participant within this complex construction is a very difficult task.

So this is again a very heterogeneous area that I have to do, which starts at the European level and goes down to the urban level.

Carsten Wolff [93]

You have a small state here in Germany, where several hundred transport associations work together with individual tariff systems and their respective transport companies, and each transport company and transport association thinks it has to develop it´s own app, which is owed to it´s own tariff system. None of this is optimal.

Michael Kuhn [96]

The public transport requires specific mentioning, which is the view of the experts not interested to share or work on a compounding of all transport modes.

It's sad but actually assume that they are grown power structures that you wouldn't want to let go of and that's sad but unfortunately true.

Michael Kuhn [96]

A further problem is the German habit to overregulate things, which makes it difficult to implement new technologies and, as already shown, new technologies are essential for the new concept.

We Germans have a tendency towards over-regulation. In my view, this has not improved in recent years and the result today is a location that is difficult and simply lagging behind.

Michael Kuhn [96]

Lastly, the structure of the government is questionable if new technologies must be implemented, and on the other hand, the government itself cannot keep pace with quickly developing technology changes.

What I find difficult is that the design framework is not evolving nearly as fast as the IT and MaaS systems are evolving and certainly not as fast as the growth is evolving.

For example, you can take the rental bikes in Brussels, which were very popular last year and have been completely replaced by electric scooters this year. There a state organization is not able to act so fast and to change back and forth so fast. Of course they need long-term planning and perspective in order to shape. If then some people come today I do this and tomorrow I do that, then it collides with each other.

Hartmut Reupke [95]

In summary, in this part, the statements of the experts describe parts of MaaS with the cooperation of the public and private sectors and the political framework. These two aspects are essential for MaaS and are also in the scope of the German government. The indicated problems within the system to enable this system will be part of the roadmap and the action plan for the German government in Chapter 7.2, where possible solutions will be presented.

6.6   E-Mobility

The last of the interviews with the experts in Germany covered the subject of the potential of e-mobility in the overall change of the mobility concept. The reason is, on the one hand, to figure out which role e-mobility should play in the future concept and, on the other hand, how a new mobility concept could even support e-mobility. As already shown, the objective for the new concept is to correlate the climate goals with the megatrends and people's necessities. The best way to summarize the experts' statements is a process diagram, where at first the current problems of e-mobility are shown. In the next step, the possibilities to solve these

problems and then present the way e-mobility can help achieve the previously-mentioned fundamental goals, like the climate goals, the megatrends and the customers' needs.

Last week, the Federal Minister of Transport explained at the Conference of Transport Ministers that in order to achieve the CO2 emission targets, new drive systems are needed in the teaching sector as well. Electric mobility in the form of battery-powered mobility is one possibility, but new technologies should be developed openly.

Jens Petershöfer [94]

Problems with E-Mobility
- Charging in high-density areas
- Payment systems
- Registration for several providers

Solution
- MaaS as aggregator for the new transport mode
- Solving the last mile problem

Correlation with fundamental targets
- Locally fewer emissions
- Easiness to use
- Combination of MaaS and E-Mobility can help each other take a step into the market
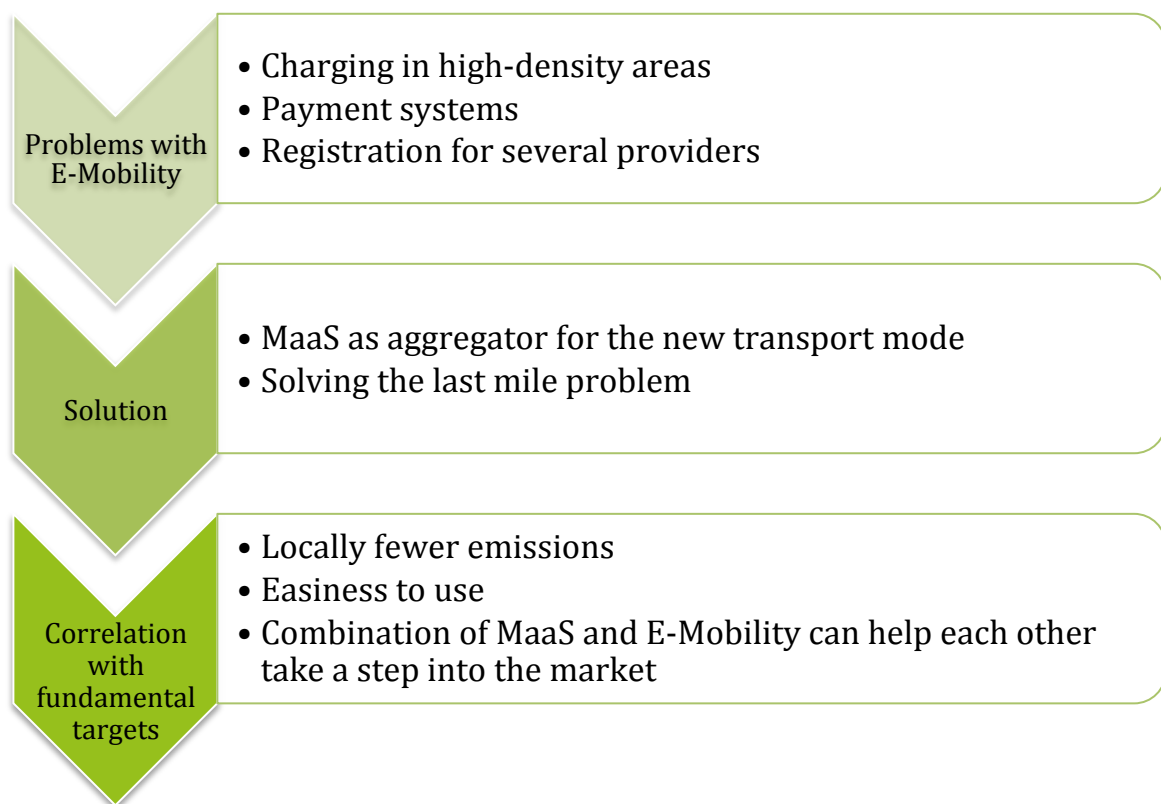
Figure 25 - Process of e-mobility to reach fundamental goals

The first point includes the problems experts see with e-mobility and, in particular, with e-vehicles at the moment. Especially the charging infrastructure and the charging in high-density areas are problematic, which must be solved before it can be a real alternative to conventional vehicles.

If you go into a densely populated room, where for example a multi family house is located with six floors , then I lack the imagination of how the number of loading columns should be provided for the individual inhabitants. In fact, it simply doesn't work.

Jens Petershöfer [94]

A further problem with the charging infrastructure is that there a several different providers for charging, which require a registration and a compatibility with the car.

At the moment [,] I have the problem that when I am travelling with an electric vehicle and see a charging station [,] it does not mean that I can use it. I also have to register individually with each utility company to be able to use the charging station.

Jens Petershöfer [94]

An additional point that comes with E-Mobility is micro mobility. As already explained, micro mobility gives many opportunities to solve, for example, the last mile problem, but it is also not safe enough to be operated on the streets in the view of an expert.

In the case of the new constitution for very small electric vehicles, we at the Federal Ministry of Transport initially opposed it because we do not yet see a liberal opening, but a much stricter framework is needed. The danger that goes along with this is much greater than the chance we see now.

Hartmut Reupke [95]

Therefore, it is clear that e-mobility has some difficulties being used by the masses. The experts were asked if there are ways to change these difficulties into advantages. One aspect mentioned by everyone is pooling, sharing or – in summary – an aggregator. An aggregator, as for example MaaS has in it´s concept.

The first point is the difficulty with the charging infrastructure and the charging in high-density areas. In the point of view of the experts, pooling and sharing is the only solution for this problem.

If you go into a densely populated room, where for example a multi family house is located with six floors , then I lack the imagination of how the number of loading columns should be provided for the individual inhabitants. In fact, it simply doesn't work. If something like this is used via service offers, then of course this is omitted, because they simply don't need so many vehicles any more.

Jens Petershöfer [94]

The second problem is that several providers of charging infrastructure with different payment systems and registration are on the market. In this case, an aggregator or MaaS can be the solution, because they would be summarized under one service provider, which increases people's comfort.

This is something you could make forgotten as a service provider. You don't have to worry about the registration or the billing anymore. Here I already have an advantage by the connection of MaaS and E-Mobility. I do not have to worry about what I should do at home with the car.

Jens Petershöfer [94]

The safety point of small transport modes such as e-scooters is an issue that must be solved, but the advantages of micro mobility in combination with MaaS are shown not just in this following statement, but throughout the whole previous Chapters.

I was at a technology festival in Austin just last week and it was remarkable that E-Scooters and so on were spread all over the city centre and people were constantly moving from one location to another. At some point you just can't walk anymore and so the city was flooded with E-Scooters from five suppliers, some of which were offered by Uber or Lyft. I think you saw that they could contribute to the relief of urban mobility.

Michael Kuhn [96]

If you include the other means of transport and we simply have new players at our disposal. Let me give you an example. We have a public transport stop and originally you walked there, which means that we have a radius of about 300 meters that such a stop opens up. Then someone clever came up with the idea to put a bicycle stand there and I had already increased the radius of entry to easily one kilometre to even 2 kilometres. With E-Bikes, I have increased this again clearly.

Jens Petershöfer [94]

All in all, it is already clear at this point that e-mobility and MaaS can be a solution if they can be implemented in tandem. First, the local emissions, which are crucial for urban areas, can be decreased.

E-Mobility fulfils a certain function. E-mobility ensures that we initially only have fewer emissions locally, which is an important task, at least in densely populated areas, and must be fulfilled.

Jens Petershöfer [94]

Furthermore, the combination gives not just an easy access to e-mobility and sustainable transport, as previous mentioned, these aspects could also push each other onto the market, as Jens Petershöfer describes.

E-Mobility is hip, the offers are modern, and accordingly it fits together from the story. One has a modern offer and a modern vehicle and combines it to a modern product. So nobody dares to think like we have a modern mobility concept with a Euro 5 diesel. It just doesn't fit. On the one hand, this is a marketing instrument and helps in the concentrated areas.

Jens Petershöfer [94]

When gathering all these statements, the aspects mentioned in Figure 25 must be fulfilled, i.e. if e-mobility wants to succeed on the German market and replace the current structure. Jens Petershöfer describes that especially customers' convenience has to be in focus of the development. Not just the change from conventional cars to e-vehicles will be the solution for the fundamental problems, but also the combination with a new mobility concept can bring a real change.

I've already mentioned one. The service provider must exempt the user from all these considerations and there must be no regulations as to which provider may be used. There must simply exist framework contracts to offer this service. What needs to be clarified is what happens to vehicles standing in the street. There has to be a service like for example in Berlin where certain people locate the vehicles and then bring them to the next charging station, so that they are available again at the latest the next morning. This has to be convenient for the user and that's what's at the top of the list. If the offers are accordingly convenient, then people are also willing to pay a certain amount for them. Convenience is probably the best way to sell things.

Jens Petershöfer [94]

Throughout all sections of this Chapter and the interviews, it is clear that the German government is aware of the necessity for a change in how transport and mobility is used currently. The solutions are partly evident. At the moment, the most important problem is to summarize all knowledge and give a clear vision for future mobility in Germany. Precisely here is the main part of this paper, where several statements will be gathered and put into a road map. The next Chapter will associate the knowledge achieved from the experts in Finland and Germany.

Nevertheless, before a fundamental change in the mobility concept can be implemented in a huge ecosystem, as the German is, a clear and systematic proceed has to be used. Therefore, the next Chapter will be based on Annex XX, which describes change management gives a framework for the road map at the end of this paper.

7 Roadmap for Germany to MaaS

7.1 Restructuring of transport in Germany

Previously, it was already mentioned that the world is confronted with changes. In addition, the mobility sector has to deal with these changes. The global megatrends, new technologies and social innovations, which are driven by digitalisation, urbanization and the climate change, influence all life situations. The interviews with the Finnish and the German experts have shown that the authorities in both countries are aware of these challenges or, as previous declared, fundamental problems. Both countries try to find a way to master these challenges, as was shown in the preceding Chapters. These Chapters also have shown that the experts found a new concept with MaaS and receive support by the government, so the concept can develop quickly and, most importantly, in the right direction. Moreover, the German interviews have shown the necessity for a change in the mobility concept. The described key points are very similar to the vision of the Finnish government. In this Chapter, a way to implement MaaS and support the market entry of E-Mobility will be shown. At first, the requirements for a sufficient MaaS implementation will be summarized and displayed in Figure 26. Furthermore, the connectivity between the infrastructure and the service will be pointed out.

Mobility as a service
Mobility-as-a-service operators (big & small), multiple customized services, all transport modes with single user interface, Internet of traffic.

Integrated online services and interfaces
Online services platform: Open Data, Interfaces and APIs, cloud services, Internet of things

Intelligent traffic infrastructure
Traffic management systems digital ticketing, routing services seamless connectivity

Telecommunications & Charging infrastructure
Mobile data networks 4G/5G static networks enabling international interoperability, broadband for all

Core infrastructure
Roads, rails, airports and ports. Growth corridors

Figure 26 - Core Elements of MaaS [107]

MaaS is an intelligent transport system that combines all components of the production of a user service using real-time and placed-based data.

If you are tapping into those big [,] big changes, you actually start connecting into a mobility mix and that's where we do massive shares. But here you have the biggest challenge and the biggest possibility. So how we make that whole complex more efficient? Its through data. If we have data running through all these different knots[,] it has the possibility to improve everything. The operations or the services and so on and get whole closer to what the customer needs.

Krista Huhtala-Jenks [76]

Therefore, it is essential to open the APIs and give the companies the access to the necessary data.

With the open APIs [,] the real time availability and pricing will come to the transport system and that will then create a holistic possibility to the transport system.

Anne Berner [85]

As in the most interviews listed, the essential change within the mobility sector will be the switch from a transport mode oriented to a user-orientated mobility concept. With the customer in the centre and the transport modes around them, it is possible to point out the needs of the people and address the fundamental problems, which were presented in the introduction.

User orientation is something that I have lived with all my life as an entrepreneur. So that was something I felt is very right to turn service more towards the user instead of only looking after interest of the service providers and to the structures.

Anne Berner [85]

Furthermore, it was mentioned that new business models have to be enabled. New business models are a key point to enable a change to the previously-mentioned point of user orientation and to give the companies the opportunity to create profitable businesses.

It is important to have good start ups or old companies coming up with new innovative business models and service types in Finland an even export them outside of Finland.

Saara Reinimäki [89]

[...]that more and more people in start-up areas realize what can be done with data and because mobility and data are closely linked, a lot happens in this sector. Many different business models are being developed [...]

Hartmut Reupke [95]

Even more important aspects are the efficiency, sustainability and accountability in the transport mode. Reaching the climate goals mentioned in the *"national climate protection plan 2050"* [48] and interviews is one of the main drivers for the necessity to change.

Transport is the biggest problem in climate protection. Therefore, we cannot leave the car industry out of responsibility. After all, road traffic still accounts for the majority of emissions.

Svenja Schulze; Federal minister of environment [5]

So we want to be the forerunner for enabling these new mobility services, so we are able to reach the climate targets.

Noora Lähde [78]

Last week, the Federal Minister of Transport explained at the Conference of Transport Ministers that in order to achieve the CO2 emission targets, new drive systems are needed in the teaching sector as well. Electric mobility in the form of battery-powered mobility is one possibility, but new technologies should be developed openly.

Jens Petershöfer [94]

To enable all these changes, the main statement of the most experts is that the public sector has a key role. The regulation and legislation, the subsidies, incentives and the pricing are the most effective ways to enable the development and create new markets. Especially the balance of serving the society and the business world is an important part, which has to be steered by the government.

First, we did a change in the ministry's organisation. We reorganised the whole ministry and we said in our communications, digitalisation and transport are more integrating, that means that we have to make sure that we integrate our legislation and so the ministry was reorganised.

Anne Berner [85]

Furthermore, an important point, which was mentioned throughout the interviews, is the potential of MaaS and e-mobility in tandem. Especially the last mile problem and the local decarbonisation are in focus here.

In order to unlock the whole environmental potential of MaaS, e-mobility will be used and all these MaaS providers of fleets would use E-Mobility, [...] because public transportation is not comprehending enough services for the end-users, but when you get public transportation and different new mobility services – car sharing, ride-sharing, E-Scooters/Bikes, Bike-sharing, whatever – then we are able to provide comprehensive services.

Piia Karjalainen [87]

E-Mobility is hip, the offers are modern, and accordingly it fits together from the story. One has a modern offer and a modern vehicle and combines it to a modern product. So nobody dares to think like we have a modern mobility concept with a Euro 5 diesel. It just doesn't fit. On the one hand, this is a marketing instrument and helps in the concentrated areas.

Jens Petershöfer [94]

To figure out how to implement MaaS in combination with e-mobility, it is necessary to point out the strengths and weaknesses on the one hand and, on the other, the opportunities and challenges of the German transport sector. Therefore, the SWOT-analysis (see Figure 27), which is based on the expert interviews and literature, will be used [101]. It will be used to examine the potential of the German transport market for a change in the transport sector. As it is displayed in Figure 27 the German market has a lot of potential, but also a lot of risks and weaknesses. The opportunity to make a change and have the chance to create and develop an own mobility concept are there, but the outlined conditions regarding legislation, society mind set and especially the willingness to create an open ecosystem by all players is necessary.

However, before analysing these changes and influencing potential by the government, a SWOT-Analysis will be shortly preceded. The SWOT-Analysis is a combination of the given expert interviews and the previously-presented literature research. This summary will help develop an action plan or road map (7.2 Action and roadmap) for the German government to implement MaaS.

Strength

- digital knowledge capital
- public and private transport operators are aware of change neccesity
- Stable and predictible society
- sustainable transport system
- financial ressources and big scale operations
- high amount of experience in development of new eccosystems that regards high investments
- plenty of determined international interest
- plenty of large companies in the automotive industry

Weaknesses

- not a global leader in digital businesses
- low bindings between public and private sectors
- disproportion between goals and targets
- high amount of venture capital
- inexperience in commercialisation of platform solutions
- legislation
- test sites
- global open standards
- missed pioneer position
- extremly heterogenous market

German Transport market

Opportunities

- enabling changes in legislation
- creating new businees fields (artificial inteligence, sensor technology, autonomous driving, computer security, data protection)
- strong international relations give the opportunity to test in different environments (social, weather, economic)
- world leading conditions for start-ups
- strong network between start-ups and established companies
- having the chance to develop an own mobility concept
- creating a mind for environmental mindset in the society
high-density areas are available

Threats

- digital infrastructre needs high amount of investments
- closed ecosystems has been been created up until now
- monopolies by big global players dictate the market
- public authorities lack in making changes in the legislation
- fear of privacy regulations in society
- other markets attract the global players and experts more
- no willingness to create an open-ecosystem approach

Figure 27 - SWOT-Analysis regarding the German transport Sector[102][5][103][104][105][106]

7.2   Action and roadmap

As already mentioned in Chapter seven, the main hypotheses will be analysed. The first two were already analysed in Chapter 7.1, where the reason for MaaS as a successful new mobility concept was outlined and the role of e-mobility within this concept edited. The last question or part of this paper is the possibility of the German government to support the market entrance of e-mobility in combination with MaaS. Therefore, it is necessary to use all previously-gained knowledge. It demonstrates which influences are taken into account to create a road map that describes the role of the public authorities in the process of implementing a new mobility concept. The roadmap is based on the expert interviews in Finland and in Germany as well as on the literature. As basic strategic framework the introduced change management process will be used, as figure 28 demonstrates.
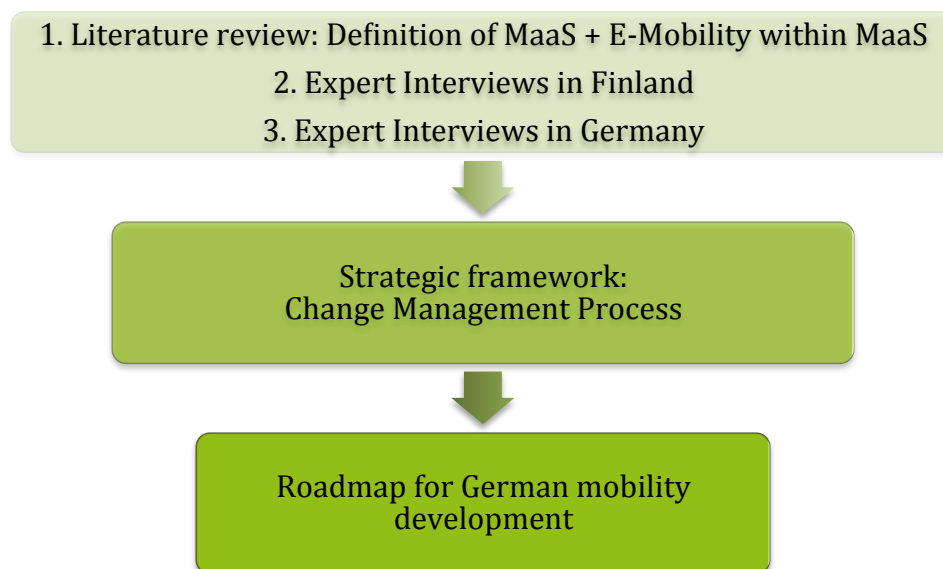
Figure 28 - Development Process for the Roadmap

| Creation of a clear vision for future mobility | Definition of specific targets to reach the vision of future mobility | Creation of actions, which helps to reach the defined targets |

Figure 29 - Change Process for the mobility sector in Germany

The first and most important point is to formulate a clear vision. This will help create a common understanding and give all involved players the understanding why a change is needed. This major first step is not just mentioned as fundamental part in a change management process (see Annex A) but also clearly delineated during the expert interviews.

For example [,] when we arrange some kind of seminars and meetings then we put the companies and the public sector together and spread the word that this kind of trials are on-going, because this is part of the big picture and also knowing what is happening there and not doing it twice. So having these open seminars to say what kind of things are happening.

Noora Lähde [78]

We had a good preparation and transparent exchange with the companies. We had a lot – we called them - round table discussions during the preparation of the law.

Anne Berner [85]

A further significant aspect is that all involved participants in the mobility sector create the vision together. During the expert interviews, this was called the private public collaboration, which is essential, so not just a common understanding will be created, but a vision everybody worked on together.

So you have to involve all stakeholders in the preparation and that's what we did and still been doing very closely. […] we really used a lot of time to sort of create a common understanding about what needs to be done and try to address the concerns.

Laura Eiro [83]

There are several aspects there. First, there is a mobility advisory board, where political parties are represented and are also in the House of Representatives, there are associations from the ADAC to the IHK within it, but there can also be smaller or larger associations within it, which represent certain interest groups, there are administration and districts within it. This is a very broad mix of all those who have to do something with the topic of mobility at the most diverse levels and then we bring in individual actors to the individual special topics.

Hartmut Reupke [95]

Not to be forgotten is that the government itself has to steer the entire process. On the one hand, the major goal is to make mobility more efficient and sustainable. On the other hand, there is a party that gives everyone the chance to freely mention their opinion, and not just the most powerful players in mobility will be heard. Furthermore, the government is the only authority that has the power to mediate between different parties during conflicts, as the following statement from Anne Berner demonstrates.

I don't think that was the point, but the taxi industry was reluctant to give up the protection that they had from the government. [...]So either they are out of it – of the whole MaaS – or they are in.

Anne Berner [85]

In addition, the personal involvement of the public authorities shows other parties the importance of the topic.

The minister had a lot of them and assisted and that helped a lot. She took a lot of personal interested in it and I don't think it could have been this successful, because she showed that she is committed and then everyone else wanted to commit.

Saara Reinimäki [89]

In Germany, there is currently no clear vision each participant works toward. Therefore, the first major task for the German government is to create a vision in cooperation with all participants of the mobility sector. For example, the defined vision by the Finnish government is:

According to the vision and Roadmap of the Research and Innovation Councils reporting to the Prime Minister's Office, by 2030 Finland will be the world's most attractive and knowledgeable environment for experimentation and innovation. The Councils vision and roadmap provide a common direction for RDI policy, where solutions to global problems are arrived at and international demand is kept pace with. The Councils long -term aim is for Finland to have several business-driven growth ecosystems involving billions of euros, which produce competitive solutions to meet global needs.

National Growth Programme for the Transport Sector Finland [107]

From this point in the second step, an attractive plan has to be elaborated. Therefore, it is important to develop a clear plan for the future direction of the mobility system. Parts of this plan are clearly-structured goals, as for example the emissions goals 2050. In addition, here, the collaboration of the government, the industry, but also of experts is very important. During the whole change process, it is essential that all participants are taken in account, so everyone feels valuable and heard.

Also important, at this point of the process, is the identification of specific goals. Along the vision, clearly formulated goals must be elaborated. Germany already has goals but, as already mentioned, there is no clear vision above each formulated goal. Even more important is that each goal cooperates to reach the main vision. Otherwise, there are maybe goals that are helpful in isolation but maybe don't help each other reach the main vision and can even interfere with each other.

During the interviews with the German experts, a clear and common vision couldn't be identified and also a major nationwide collaboration couldn't be found. Therefore, the government in Germany has to generate a nationwide collaboration to create specific goals out of the previously-worded visions. For example, it can be defined which contribution the mobility sector can provide for the emission goals. Not only environmental influences shall be taken in account to define goals but also social ones, as Figure 30 shows.

What we shy away from are always prohibitions, because these are always connected with massive effects, also social effects. Only as an example there would actually be a ban for diesel vehicles, this is automatically a huge social problem, because usually owners of older vehicles will also hardly be able to spontaneously allow an expensive new replacement.

Jens Petershöfer [94]

Environment	Society
Targets for transport and moblity future	
Economic	Technical development
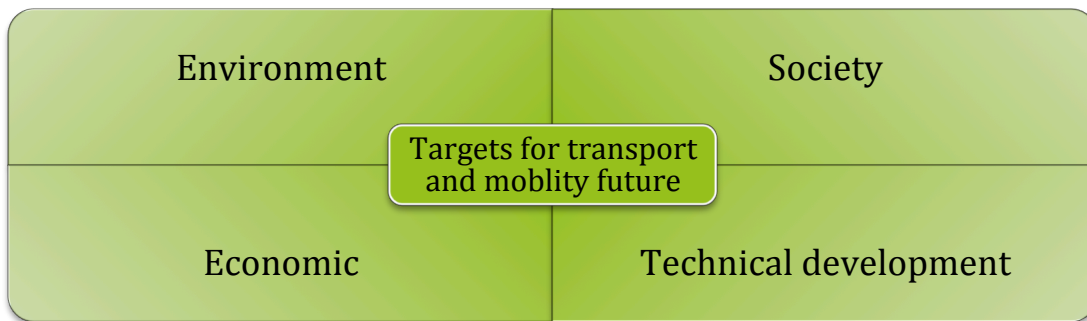
Figure 30 - Decision-making influences to create specific goals for the transport and mobility sector

As already mentioned, it is very important that each goal first contributes to the main vision. Even more important is that the goals don't interfere with and even help each other.

You kind of twist everything around the user and then put that all together and that brings us the new way to organize mobility.

Sonja Heikkilä [88]

Just after these two steps, clear actions can be worked out to develop the mobility system from the current to the desired state. The first question to ask here is if the current structure of the government fits the current times and helps reach the formulated goals.

First, we did a change in the ministry's organisation. We reorganised the whole ministry and we said in our communications, digitalisation and transport are more integrating, that means that we have to also make sure that we integrate our legislation and so the ministry was reorganised.

Anne Berner [85]

For example, you can take the rental bikes in Brussels, which were very popular last year and have been completely replaced by electric scooters this year. There [,] a state organization is not able to act so fast and to change back and forth so fast. Of course, they need long-term planning and perspective in order to shape. If then some people come, today I do this and tomorrow I do that, then it collides with each other.

Hartmut Reupke [95]

The development of this Chapter outlined the most important first steps for change from the current mobility concept to MaaS and the new way of using mobility, which helps reach the climate goals and contributes to the inclusion of further developing megatrends society is confronted with.

8 Conclusions and Future Research

The following Chapter will summarize the results of this thesis and give an outlook on future research ideas.

8.1 Conclusions

At the start of this thesis it was clear that society and also mobility are facing elemental megatrends. The current mobility system is not able to master these challenges because it is characterized by individual mobility that is inefficient. This thesis focuses on the role of the public administration to support the change from the current mobility system to MaaS as an alternative mobility system. Furthermore, it put into focus how e-mobility can be implemented through MaaS and even be an enabler for the implementation of MaaS. To describe the role of the public administration, a roadmap was created, which is a guideline for the public authorities in Germany. This roadmap was created by synergizing expert interviews from Finland and Germany. Firstly, the reason for MaaS as solution for the challenges was explored. Secondly, the role of e-mobility within this new mobility system (see Chapter 7.1) was analysed. Lastly, the change process itself, from the current mobility system to MaaS, was described. All in all an action list was created (see Chapter 7.2) that advises the government to enable and accelerate this change process. In Figure 31, the main results of this thesis are summarized. The results of the literature research and the interviews coalesce into this figure.

Need of change
- Megatrends and climate targets makes a change in the mobility system indispensable
- Technological development gives new opportunities
- Inefficient use of resources

Reason for MaaS
- Use of current infrastructure & resources more efficient
- Takes new technologies in account
- Reflects megatrends
- Creation of new business models
- User orientation

Conditions for MaaS
- Physical services and infrastructure
- Data access for MaaS-Provider
- Cooperation between public & private sectors

E-Mobility and MaaS
- Solving last-mile-problem
- Reduction of local emissions
- Affordability & freedom of risk
- Leverage each other

Roadmap
- Conditions for the new transport mode in Germany
- Government as steering wheel for change process
- Involve everybody in change process

Figure 31 - Main Results of this Thesis

As the development of this thesis developed, the role of the public administration is extraordinarily important. For such disruptive changes in an important ecosystem, as the mobility system is, there is a need for a steering authority with the power to encourage all participants within this ecosystem to work together. Furthermore, the public administration can lead a way to reach the previously-mentioned goals. For that, it is important that firstly the structures within the public administration are prepared to support fast and essential changes. Secondly, there has to be the will to make difficult decisions that will not make everybody satisfied. Thirdly, the adequate people must be in the main focus of each decision.

As this thesis has shown, the role of the public administration is important, if a change of the mobility system from the current to MaaS that supports the dissemination of e-mobility must be implemented. Nevertheless, along this way, many further questions accrued, which will be displayed in the next Chapter.

8.2 Future research

The role of public administration within the implementing process of MaaS and e-mobility in Germany is the main examination point of this thesis. As main analysing tool, the interviews have given a wide and detailed overview about the key questions but also about further topics. Figure 32 gives an overview about possible research topics within the fields of business development, legislation, technical and social aspects. In each of the following presented topics the questions are: how can it be implemented? What are the effects? What benefit does it bring for MaaS?

Business
- Analyzing business model possibilities for Germany
- Effects of MaaS on current business
- Development of a MaaS platform in cooperation with a mobility provider

Legislation
- Current state of the art in transportation regarding MaaS implementation
- Possibilities to change legislation regarding outlined points (e.g. opening API)
- Increasing the speed of allowing pilot projects

Technology
- Designing the charging infrastructure
- Increasing the range and charging speed of EVs
- New technologies that can be implemented in the MaaS-System

Social
- Social acceptance modelling of MaaS (TAM)
- Social simulation of integrating MaaS in the mobility
- Identifying user groups that are already willing to use MaaS
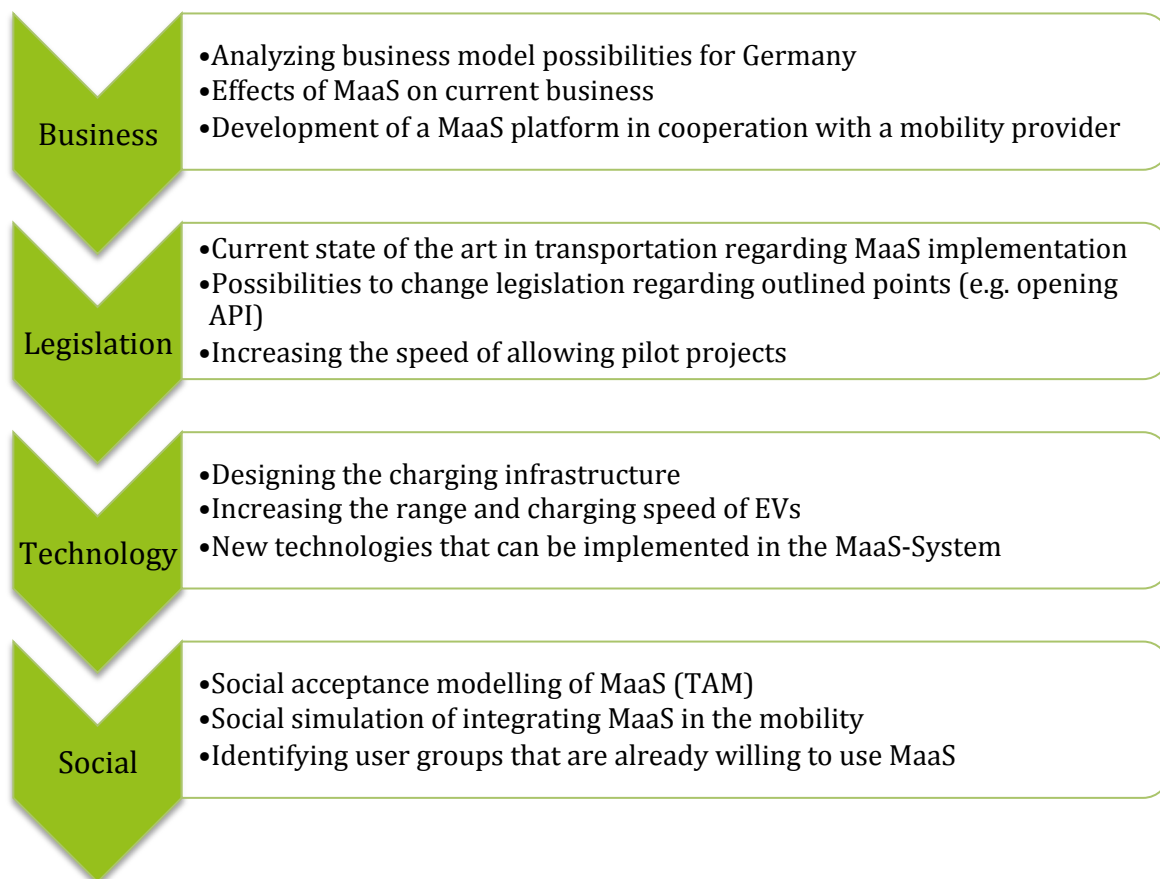
Figure 32 - Future Research Fields

In this thesis the business model possibilities were demonstrated. For example, it is possible that the current big players in Germany, like the automotive companies and the public transport providers, work together and create a MaaS platform. Therefore, the opening of the market is not necessary, and the already existing structures and legislation framework can be used. A second option is to open the market for new players by giving an open access to transport data, so a new business field will be created where every player has the same chances to create MaaS platforms. A future research question regarding this point can be the examination of the best option for the German market. Additionally, the effects of a change from the current mobility system to a MaaS-System for the current players can be a future research topic.

The second field of future research questions is the legislation in the mobility sector. One important question is the theoretical possibility of MaaS to be implemented within the current state-of-the-art in the legislation. Even more important is the point of regulation of opening the data and the elaboration of a legislation change regarding this topic. Here it should be in focus to make suggestions for detailed legislation changes, which would encourage the implementation of MaaS. Another topic, which was also mentioned in this thesis, is the high amount of pilot projects and the quick processing of pilot project requests in Finland. Due to this, it would be interesting to examine a possibility to have the same conditions in Germany, so research projects can be tested and implemented more quickly.

Thirdly, the technological development of, for example, the range and the speed of charging of EVs is an important point that must be worked on in the future. But also, the design of the charging infrastructure and the implementation in the current network are important aspects. An even more important point is a continuous process of integrating new technologies into the system of MaaS, as for example new travel planners or autonomous cars.

Because of the high impact on people's everyday life transport options, it is very important that social aspects are part of future research work. For example, social acceptance models can be executed where theoretical social models can be applied on MaaS. Furthermore, simulations can be done, like effects of MaaS on traffic flows,

identifying conditions under which every person is willing to use MaaS or even just identifying potential user groups that are already interested in using MaaS in Germany.

All in all, the fact that MaaS answers the current challenges in mobility and also reflects the megatrends in mobility gives researchers the necessity to keep up with the study of MaaS itself, but especially the implementation process in Germany. This thesis has shown that there are challenges in the implementation process of MaaS in Germany, but it has also shown that with the involvement of the government and a clear vision of the future of mobility in Germany, the challenges can be mastered. The thesis has also shown the high potential of creating not just national business models but also international products, which can be profitable for the companies. Nevertheless, the concept of MaaS mainly represents the needs of people. Users would benefit the most from the change in the mobility sector.

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Annex A: Excursus – Change Management

In this part, the theory of change management will be described. This is necessary to understand the further approach of creating a roadmap for a successful implementation of MaaS in Germany. Change Management is a phenomenon of a corporate business process that describes the adaption of strategies and structures to changing conditions in the world. All processes of global change, be it through revolution or through planned evolution, fall into the area of change management. This includes corporate and business transformation, which are executed through reengineering and organizational development. One characteristic paradigm of this organizational development is the harmony postulate between the objectives of the company and the employees' concerns.

MaaS is a transportation concept that needs a change of the current mobility notion. The reasons for a need of change were already given in previous Chapters.

For the concept of MaaS, an example based on a corporation is useful. Enterprises are adapting normally and continuously to the changing demands of the market, like technological development, competitors or cost and price pressure. This on-going process is very important, and the recognition of even weak signals from the market is significant. As example Nokia, a Finnish company can be used, which didn't recognise the signals on the mobile phone market with the technical development of smartphones. The missing development led from market dominance in 2010 to a complete disappearance from the market in 2012.

The process of change management can be described in four stages (see Figure 33). As it is displayed, the environment is developing constantly and dynamically. In stage one, the companies can follow the development of the environment. In stage two, they lose the connection and can't follow the speed of the outside development. At this point, first weak signs are recognisable. If these are not perceived, a strategical drift starts, and the company has to implement radical changes to get back on track.

Precisely this intervention into company structures is change management. Characteristic fields of radical changes of organisation are:

1. Build up new business fields

2. Restructure the company

3. Change of strategy, success factors or positioning
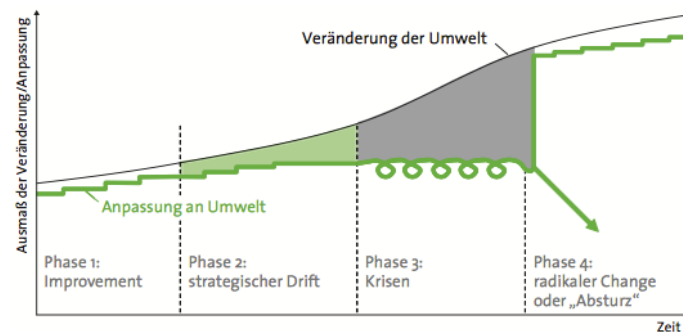
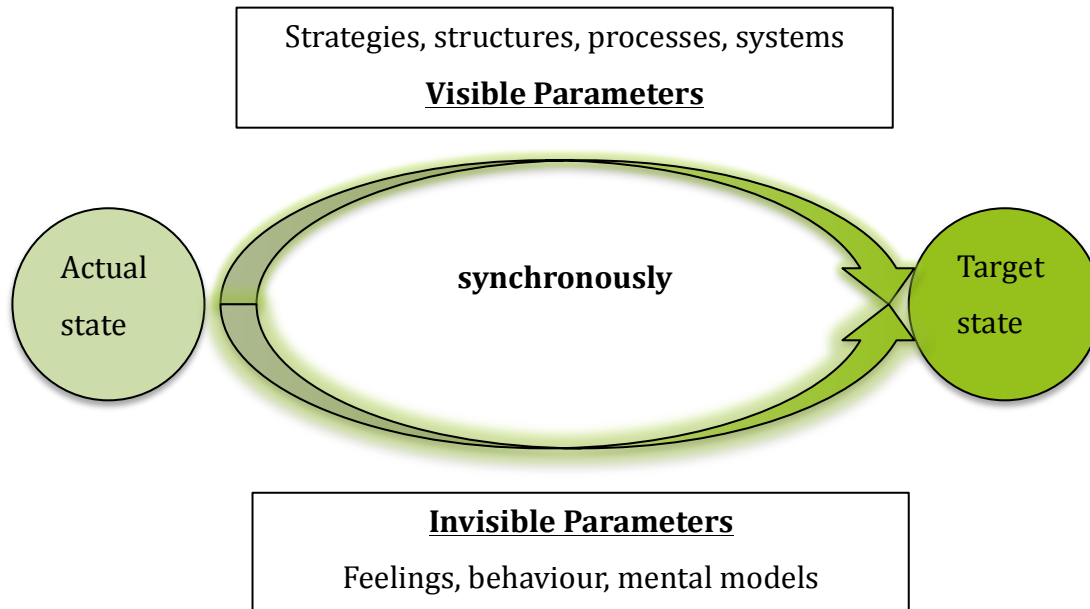**Figure 33 – Phases of Change Management Processes [98]**

A successful change process always follows a three-step logic [99]:

1. Creation of a common understanding of the situation → "Why should we change?"

2. Development of an attractive future or a sufficient state → "In which direction should we develop?"

3. Working out a way to get the organisation from the current state to the desired state → "How shall we reach the new goals?"

This kind of developments always needs an on-going observation, corrections and a holistic or systematic organizational understanding. The understanding of classical management situations contradicts this, where everything follows a cause-effect correlation and linear planning.

Therefore, it has to be paid attention to visible parameters like structures, processes, systems and strategies, and also topics that are not so easy to see. To this type of parameters, personal reactions belong, like feelings, behaviour, and mental models. Only if both fields are involved, a change can be successful. For example, the

structures and processes of an organisation are only feasible if the parties involved are really affected by this change. So this means that changes must be synchronous in both fields, which is shown in Figure 34 [100].

Strategies, structures, processes, systems
Visible Parameters

Actual state   **synchronously**   Target state

Invisible Parameters
Feelings, behaviour, mental models

Figure 34 - Change Management Process

When we bring this process in connection with the topic of this Chapter, where a roadmap for the implementation of MaaS in Germany will be created, it becomes clear that this change in the mobility sector needs, at first, for people to commonly understand why a change is necessary (see Chapter 1).

Annex B: Datasheets

Interviews Finland

Transcriptions can be requested.

Interviews Germany

Transcriptions can be requested.

Mayring Tables Finland

Mayring tables can be requested.

Mayring Tables Germany

Mayring tables can be requested.

114Annex B: Datasheets

Given statements in each category

Name	Introduction	Need of Change	Reason for MaaS	Implementation - Properties	Implementation - Government	Satisfaction	E-Mobility	Germany	Total
Sonja Heikkilä									
Krista Huhtala-Jenks	4 10,3%	2 5,1%	2 5,1%	14 35,9%	10 25,7%	1 2,5%	3 7,7%	3 7,7%	39
Laura Eiro	2 2,9%	9 12,9%	6 8,6%	14 20,0%	22 31,4%	3 4,3%	10 14,3%	4 5,7%	70
Mika Kulmala	2 5,9%	2 5,9%	5 14,7%	6 17,7%	14 41,2%	1 2,9%	4 11,8%	0 0,0%	34
Tommi Lampikosi	2 5,6%	1 2,8%	1 2,8%	17 47,2%	10 27,8%	0 0,0%	5 13,9%	0 0,0%	36
Jemina Uusitalo	1 3,0%	1 3,0%	5 15,2%	21 63,6%	5 15,2%	0 0,0%	0 0,0%	0 0,0%	33
Noora Lähde	2 4,4%	5 10,9%	5 10,9%	5 10,9%	19 41,3%	5 10,9%	5 10,9%	0 0,0%	46
Saara Reinimaki									
Anne Berner	2 4,4%	1 2,2%	4 8,9%	11 24,4%	21 46,7%	3 6,7%	3 6,7%	0 0,0%	45
Piia Karjalainen	2 7,1%	2 7,1%	7 25,0%	8 28,6%	5 17,9%	0 0,0%	2 7,1%	2 7,1%	28

Table 12 - statements in each category

Expert election for the Interviews in Finland

Name	Position	Date of interview	expertise
Sonja Heikkilä	Program Director on Mobility Services at OP Financial Group	08.03.2019	Pioneer with her thesis about MaaS
Krista Huhtala-Jenks	Head of Go-to-Market - Head of Ecosystem & Sustainability MaaS Global Former Ministry of T&C	30.01.2019	Involved in the transportation and mobility sector for more than 10Years
Laura Eiro	Programm Director at ITS Finland	30.01.2019	Involved in the transportation and mobility sector for more than 10Years
Mika Kulmala	Traffic Engineer at the city of Tampere	07.02.2019	Working as traffic Engineer and digital solutions for more than 10 Years
Tommi Lampikoski	Business Manager at Gaia Consulting	05.02.2019	
Jemina Uusitalo	MaaS Project Manager at HSL (Helsinki Region Transport)	21.02.2019	
Noora Lähde	Chief advisor at Finnish transport and communications agency	05.02.2019	Working for the transport and communications Agency
Saara Reinimäki	Senior Specialist at the Ministry of Transport and Communication	08.03.2019	
Berner Anne	Minister of Transport and Communication Finland	21.02.2019	Involved into every decision about mobility as Minister of Transport and Communication
Piia Karjalainen	Senior Manager MaaS Alliance Brussels – Former Senior Advisor of Ministry of Transport and Communications Finland and EU	14.02.2019	Currently Working for MaaS Alliance to spread the idea of MaaS over Europe and former Advisor for the EU and Ministry of Transportation and Communication

Table 13 - Expert election for the interviews in Finland

Expert election for the interviews in Germany

Name	Position	Date of interview	Reason for election
Michael Kuhn	Chief Communications Officer Movel Group GmbH	19.03.2019	MaaS Provider and Chief Communication manager of joint Venture between BMW and Daimler
Carsten Wolff	Professor for Informatics at FH Dortmund	04.04.2019	Sitting in the advisory council ruhrvalley [108]
Jens Petershöfer	Group leader within the ministry of transport for mobility management, municipal mobility concepts and connected mobility	10.04.2019	Working at the Ministry of Transport in North-Rhine-Westphalia
Hartmut Reupke	Group leader for Transport within the Senate for Environment, Transport an Climate Protection in Berlin	02.04.2019	Working at the Senate Department for Environment, Transport and Climate Protection in Berlin

Table 14 - Expert Election Germany

Interview guideline Finland

Question of interest	Breakdown dimensions	Batteries of Questions	Appendix : Interview questions
How can a new Mobility concept be implemented in Germany	Change of the mobility concept	Why was a change in the mobility concept necessary?	Why is Finland implementing a change in the mobility concept? ○ ST: Could you amplify your previous mentioned point regarding … ○ ST: The previous mentioned point you said, I would like to examine under a different Aspect. In which way could MaaS support… ▪ Out-dated mobility concept ▪ More efficiency ▪ Greenhouse gases ▪ Digitalization
	Reason for MaaS	Which advantages have MaaS against other innovative mobility concepts?	1. What where the parameters of the new Mobility System? And why does MaaS were the best choice? a. ST: Could you go more in detail and explain why MaaS summarizes all parameters for a efficient and successful mobility system? b. Inter: Is MaaS the best option or are there other concepts, that would work better in your opinion? c. SP: You already mentioned the parameters that a new or modern MC needs. Could you carry the specific advantages and disadvantages out?
	Implementing MaaS	How can MaaS be implemented ?	1. How did the implementing phase started here in Finland? a. ST: Maybe you could further the point out which participants collaborated together to

			develop the idea of MaaS
			b. D: Who started with the Idea of MaaS here in Finland?
			c. D: Which actors pushed/supported this idea most?
			d. S: Could you carry out/amplify the concept that where produced to implement MaaS?
			e. INT: Would you have done or do something different as it is mentioned in implementing concept?
			2. Which role had/have the government in this situation?
			a. D: How can the government support the idea of MaaS?
			b. IND: Which advantages would the government have from supporting MaaS?
			c. SP: You already mentioned what role the government has to take to implement MaaS within a country. Could you carry the specific task or role of the government out?
			3. Which were the most controversy discussed points?
			a. S: Were there actors who were against MaaS as new mobility concept?
			4. How was the reaction of the people/ acceptance of the people?
			a. SP: Utilization development
			b. INTER: Would the implementation of MaaS be faster if the concept would be revised?
			i. Which points in detail?
			ii. Who could implement them or make a change?
			5. In which regions is MaaS growing fastest?
			a. SP: Why in detail?
			b. INTER: Would it be possible for a country to have coverage of 100%?
			i. Why?
	Role of E-Mobility /E-Vehicles within MaaS	Which role has E-Mobility/E-Vehicles within MaaS?	1. Which role has E-Mobility within the concept of MaaS?
			a. ST: The previous mentioned point I would like to examine under a different point. Which advantages and disadvantages has E-Mobility and why are the disadvantages extinguished in the concept of MaaS?
			b. D: Why is E-Mobility so important?
			SP: Could you carry your last point out and explain it more in detail?
	Possibility to implement MaaS in Germany	Is it possible to implement MaaS in Germany?	1. In your opinion, would it be possible to implement this concept in Germany?
			a. SP: could you specify this point more? (Why would it be more difficult/easier?)
			b. Which role has the government in Germany to take if they want to apply MaaS?

Table 15 - Interview guideline Finland

Eidesstattliche Versicherung
(Affidavit)

_____   _____
Name, Vorname   Matrikelnr.
(Last name, first name)   (Enrollment number)

Ich versichere hiermit an Eides statt, dass ich die vorliegende Bachelorarbeit/Masterarbeit* mit dem folgenden Titel selbstständig und ohne unzulässige fremde Hilfe erbracht habe. Ich habe keine anderen als die angegebenen Quellen und Hilfsmittel benutzt sowie wörtliche und sinngemäße Zitate kenntlich gemacht. Die Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.	I declare in lieu of oath that I have completed the present Bachelor's/Master's* thesis with the following title independently and without any unauthorized assistance. I have not used any other sources or aids than the ones listed and have documented quotations and paraphrases as such. The thesis in its current or similar version has not been submitted to an auditing institution.

Titel der Bachelor-/Masterarbeit*:
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*Nichtzutreffendes bitte streichen
(Please choose the appropriate)

_____   _____
Ort, Datum   Unterschrift
(Place, date)   (Signature)

Belehrung:	**Official notification:**
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_____   _____
Ort, Datum   Unterschrift
(Place, date)   (Signature)

**Please be aware that solely the German version of the affidavit ("Eidesstattliche Versicherung") for the Bachelor's/ Master's thesis is the official and legally binding version.