

DECEMBER 2020

MANAGEMENT SUMMARY

The Dutch Ministry of Infrastructure and Water Management (IenW) asked TNO to carry out an independent, comparative case study on the governance of Mobility as a Service (MaaS). This has a focus on a comparable scale (i.e. comparable to the Netherlands in terms of geography/number of inhabitants) through the description and comparison of international case studies and an 'end in mind' of the integration of societal goals (MaaS level 4). This study aims to contribute to global discussions and knowledge exchanges on MaaS with a focus on governance, policy and steering.

This study reviews six cases from around the globe. For each case, TNO has conducted desk research and held one or two interviews (see chapter 2). The selected cases are countries, regions and cities: Austria, Finland, Île-de-France (Paris, France), Los Angeles (USA), Singapore and the Netherlands (see chapters 3 and 4). For reference, an adjacent case has also been studied: MedMij (NL). The MedMij case is interesting in the way that they set up a healthcare information platform and standards (see Appendix 1).

The main lessons learned are that MaaS is still in the early stages of development and that it has a low uptake. Also, public authorities are important when it comes to steering MaaS, deploying policy instruments to enforce drivers and overcome barriers and stimulating public-private cooperation as part of shaping the entire ecosystem. This requires tailor-made public strategies for MaaS and the strengthening of the knowledge base on MaaS. We hope that the lessons learned from this study are relevant beyond the cases studied - for all public authorities (from municipalities to national governments) as well as for all other stakeholders involved in the MaaS ecosystem.

INTRODUCTION TO MAAS

Mobility as a Service (MaaS) "is the integration of various forms of transport services into a single mobility service accessible on demand" (MaaS Alliance, 2017). The two primary components of MaaS are (shared) transportation services (the wheels on the ground) and MaaS platforms (the apps which integrate finding, booking and payment services) which allow interoperability and easy use of multiple transportation modes and services. MaaS is thus part of the transition from mobility as a commodity (ownership of vehicles) to mobility as a service (access to trips) (Araghi, et al., 2020; Münzel, 2020).

A wide range of transport services can be part of a MaaS platform, including (combinations of) both traditional transport services (i.e. cars, public transport, taxis, bikes, rental cars) and new transportation services. The latter category includes vehicle sharing (car, bike, moped or scooter sharing) in which a fleet of vehicles can be accessed by a large group of users, ridesharing (carpooling or vanpooling) in which rides in a vehicle can be shared and on-demand ridesourcing (pooled or individual) in which a driver offers an on-demand ride to a passenger. The providers of the latter are also called Transportation Network Companies (TNCs).

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Ownership of the transport options can vary from users to the transport operator to a MaaS provider. MaaS can therefore utilise both new and traditional transportation services and integrate these into mobility services for the user.

Different 'levels' of MaaS characterise the goals and phases of MaaS development, which range from 'level 0' with no integration to 'level 4' in which MaaS service provision can be steered towards societal goals at a systemic level (Sochor, et al., 2018). Policies and incentives can be used to steer users and providers towards optimisation of mobility use in terms of societal goals such as sustainability and equity.

THE GOVERNANCE FRAMEWORK

For this study, we are particularly interested in the governance and steering approaches of public authorities (such as in choosing, prioritising, directing and steering) in cases that are relevant to MaaS. This includes questions such as: to which societal goals should the MaaS initiative contribute? What is the steering geared towards (e.g. the number of providers or users of a MaaS service)? Which policy options are applied? How is the pilot/living lab/policy organised? Which stakeholders are involved? What is the context and what are the (local) tasks and challenges? Is a specific policy instrument being tested (for example, an innovative form of purchasing, data sharing standards, etc.)?

TNO has developed a Governance Framework (figure on the right) that defines governance through six main categories and three categories of contextual factors. This framework aims to give an overview of what governance entails and support a structured case analysis.



TNO Governance Framework (TNO, 2020)

RESEARCH APPROACH

The research approach consists of three phases:

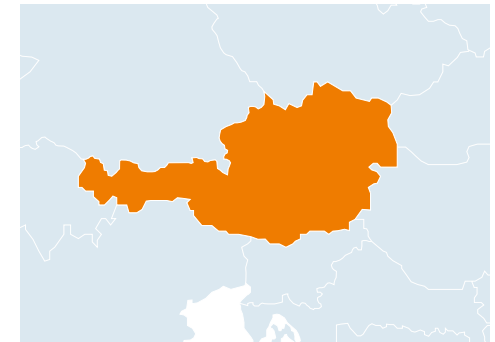
1. Establishing the research design and selecting the cases.
2. Case study analysis (desk research and interviews, analysis).
3. Finalising the case analysis, collecting more in-depth information (additional interviews), reporting findings.

CASE STUDIES – HIGHLIGHTS

For each case study analysed, these were the highlights:

Austria

- A successful early MaaS pilot in which two MaaS platforms were developed by local and national public transport providers.
- There was a nationally-coordinated MaaS programme but a political change in 2019 put a stop to this and the focus was switched to national public transport ticketing (1-2-3 ticket).
- Austria has two MaaS apps that are increasingly acquiring functionalities: WienMobil in the Vienna region and Wegfinder at the national level. Both have been developed by public transport operators and have a large uptake, yet are still mainly used for public transport services.
- Public transport is seen as a necessary backbone for MaaS.



Finland

- Finland was among the first high-activity actors in the field of MaaS.
- A legislation change opened up markets for private companies to offer mobility services.
- The national government facilitates network building, provides funding and loans for new service providers and subsidises mobility service providers when becoming MaaS-ready.
- MaaS initiatives focus primarily on the Helsinki region. Pilot projects have been set up for MaaS in rural Finland, organised into PPPs. The pilots focus on specific parts of a MaaS system (e.g. demand-responsive transport) instead of organising a fully multimodal integrated platform.

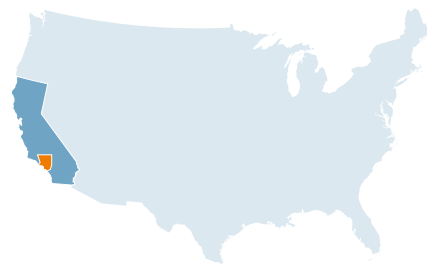


Île-de-France region (Paris), France

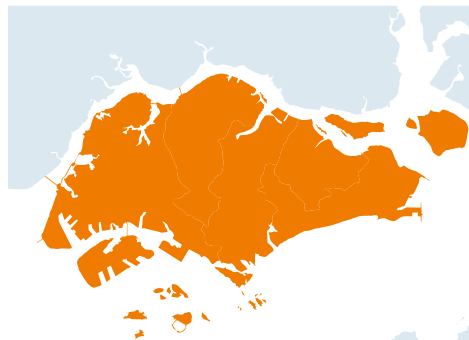
- The government is heavily involved in pilots and R&D in collaboration with private parties.
- Île-de-France Mobilités (IDFM), the regional transport authority, has its own MaaS platform and app (ViaNavigo) which provides planning, booking and ticketing.
- IDFM has set up collaboration between public and private sector parties.

**Los Angeles, USA**

- Public control of data standards is called the Mobility Data Specification (MDS). MDS was initiated by LADOT but was developed and run by a private company. This data standard is currently used for e-scooters but is expanding to taxis and eventually all shared modes.
- LADOT plays an active role in setting data requirements for apps.
- There is ample room for market parties to develop services.
- LADOT is striving to make use of a platform business model (comparable to an app store) in which they set terms and invite others to innovate on the services offered.
- LADOT has a long-term vision on steering MaaS towards societal goals and includes MDS, incentive structures and a universal booking system (the latter two are in development).

**Singapore**

- No public MaaS-specific strategy. The strategy is mostly focused on enhancing existing public transportation and regulating private vehicle use.
- Regulation of mobility takes place per mode, not across modes. The focus is on organising good access to mass movement, mainly via a public transport backbone. New mobility modes and MaaS are seen as options to strengthen this. Regulation is in place to safeguard commuters' interests.
- Public transport is dense, affordable and has a high mode share. The government sees it as the backbone for the mobility system and MaaS could be an opportunity for first and last mile connections inside the public transport system in terms of further stimulating the efficiency of the public transport system.

**The Netherlands**

- The Netherlands has a nationwide programme for MaaS.
- The programme consists of seven MaaS pilots initiated via the different policy goals of the regions involved. These pilots are largely funded by the government.
- A great deal of effort is being invested by the Ministry in order to build up public-private partnerships, a level playing field, data sharing and data standards.
- The national government is developing a knowledge and learning environment to exchange public-private data for learning. The aim is to steer policy goals through MaaS (level 4) based on data.

**LESSONS LEARNED**

The lessons learned are structured along four lines: 1) MaaS development, 2) MaaS governance and steering, 3) drivers and barriers of MaaS development and 4) MaaS outlook.

MaaS Development

- *MaaS is still in the early stages of development*
Even though MaaS is highly touted and publicised, it is still in the early stages of development. Reasons for this vary by region but include issues such as a small number of New Mobility providers in regions, a lack of mode variety available in all regions, a lack of vision and cooperation by key stakeholders on MaaS development, a lack of MaaS apps (either in development or operating) and/or a lack of uptake by users even when this is all in place.
- *All of the cases studied are primarily focussed on creating base conditions for MaaS development*
The build-up of base conditions is ongoing and focus is needed on removing barriers to enter markets. Other elements include legislative support actions and the development of data standards, data sharing requirements, interoperability and harmonisation.
- *There is generally a low uptake and utilisation of MaaS services*
This is partly due to limited implementation (e.g. a lack of availability of MaaS apps, New Mobility and other options offered in MaaS apps or find/book/pay services in MaaS apps). The few MaaS apps that have a large number of users find that most usage is focused on a single mode and not on a broad use of the many modes available in the MaaS app. Low uptake is also partly due to the public not yet embracing MaaS.
- *Each case follows its own transition path on MaaS development and uptake*
All cases studied follow their own transition paths as each MaaS ecosystem is unique. MaaS development and uptake is highly dynamic (with COVID-19 adding to the dynamics, both positive and negative), resulting in a continuously changing landscape. Each case therefore has its own complicated MaaS ecosystem, a great variety of stakeholders and its own organisation. Lessons learned should be translated such that they fit the local context.

MaaS Governance and Steering

- *Public authorities have important yet very different roles in steering MaaS*

One way or the other, we see that public authorities can have an important role in steering MaaS, including regulation, coordination and steering. However, the primary actors driving MaaS range from regional/national public authorities and public transport providers to New Mobility service providers and MaaS service providers. The ways in which these actors interact also differ. The benefits of one stakeholder driving MaaS development versus another remain unclear.

- *MaaS requires tailor-made public strategies*

The ecosystem which is already in place defines the required steps forward in a region. MaaS therefore requires tailor-made public strategies. It is important to have a strong understanding of the full range of MaaS ingredients (e.g. New Mobility options, public transport, MaaS platforms, data, steering towards societal goals and uptake) needed for a healthy ecosystem, an understanding of what is lacking in a region, an assessment of a public authorities' standing in the development of those ingredients and, finally, policy that supports the overcoming of barriers and/or protection against actions that run counter to societal goals. Governance is most effective when filling gaps in the development of MaaS in a region.

- *Public authorities use and experiment with a wide range of policy instruments to develop MaaS*

Public authorities use a range of policy instruments to develop MaaS. The main policy instruments in the cases studied are financing pilots, services, MaaS platforms and apps and roadway access regulation to ensure a level playing field. There are large differences between the cases in which a set of policy instruments are being applied and those in which policy instruments are in development. Public authorities experiment with (combinations of) policy instruments in order to learn more about their effectiveness and then tailor their actions to the phase of MaaS development. On their own, the policy instruments will not lead to an effective steering strategy; MaaS can be a means to contribute to policy and societal goals.

- *Public-private collaboration is key*

Organising cooperation between all relevant stakeholders is key when it comes to the development and deployment of MaaS. It is crucial that a representative selection of different categories of stakeholders be included, with specific attention to end-users and consumer groups. We speculate that well-formed and balanced public/private sector collaborations (tailored to the context and culture) and a strong level of trust may prove to be the most effective strategies for accelerating MaaS development. This can ensure end-user benefits while also steering towards societal goals.

Drivers and Barriers of MaaS Development

- *MaaS strategies should include actions to align with drivers and overcome barriers*

The main drivers of MaaS development are the wide variety of goals and motivations related to public, private and end-user interests. The cases focus on the development of MaaS as well as on how MaaS can contribute to societal goals. The monitoring of outcomes is often

lacking yet can strengthen development. The main barriers to MaaS development are a lack of development of an integrated approach, a lack of trust between key stakeholders, monopolistic behaviour, a lack of fact-based data and information sharing, an unlevel playing field, difficult entries to markets and the difficult scaling of MaaS uptake.

MaaS Outlook

- *Shaping the entire MaaS ecosystem requires effort, long-lasting dedication and patience*

As MaaS is innovative, its future development is difficult to predict. Putting learning and monitoring in place helps to keep track of state-of-the-art developments and progress on societal goals. In turn, this can help determine when and where action is needed. These actions take effort and a proactive, flexible and adaptive policy approach in order to be able to steer towards societal goals. Long-lasting dedication accompanied by continuity in programmes and patience are needed. MaaS development needs to be a long game focused on societal goals, creating a robust ecosystem, data standards and data sharing requirements.

- *Looking ahead, the strengthening of the knowledge base on MaaS is critical*

Progress on state-of-the-art knowledge on governance, policy and steering is needed. The priority should be given to developing knowledge on 1) implementing mechanisms to track the contributions of MaaS to societal goals, 2) mapping the institutional setting in order to define roles and responsibilities across public agencies, 3) balancing the ecosystem and organising public-private cooperation in close connection to the end-user, 4) business models that reduce both government and market failures and 5) the development of policy packages on the value case that results in the effective steering of MaaS with the end goal in mind.

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1 INTRODUCTION

1.1 MOBILITY AS A SERVICE

Despite the fact that discussions are still ongoing regarding what makes a service MaaS (Sochor, et al., 2018), the central elements include:

- User needs as the main focus
- Mobility rather than transport
- Integration of transport services, information and payment
- Access instead of ownership

In other words, MaaS “is the integration of various forms of transport services into a single mobility service accessible on demand” (MaaS Alliance, 2017).

Two primary components of MaaS can be identified: transportation services (the wheels on the ground) and MaaS platforms (the apps integrating the services) which allow interoperability and easy use of multiple transportation services and modes. These travel services are on-demand, do not require user ownership of any particular vehicle and can be mixed within a single trip. MaaS is thus part of the transition from mobility as a commodity (“I purchase a vehicle to move around”) to mobility as a service (“I purchase a ride to move around”) (Araghi, et al., 2020). This development is also referred to as the sharing economy or access over ownership (Münzel, 2020).

A wide range of transport services can be part of a MaaS platform, including (combinations of) both traditional transport services (i.e. cars, public transport, taxis, bikes, rental cars) and new transportation services. The latter category includes vehicle sharing (car, bike, moped or scooter sharing) in which a fleet of vehicles can be accessed by a large group of users, ridesharing (carpooling or vanpooling) in which rides in a vehicle can be shared and on-demand ridesourcing (pooled or individual) in which a driver offers an on-demand ride to a passenger. The providers of the latter are also called Transportation Network Companies (TNCs). Additionally, new public transit services are appearing, such as on-demand transit on flexible or fixed routes (also called micro-transit). Rail transport options can also be, and often are, part of a MaaS ecosystem and MaaS is thus not limited to road transport. Figure 1 gives an overview of the various new transport services. Ownership of the transport options can vary from users to the transport operator to a MaaS provider. MaaS can therefore utilise new and traditional transportation services and integrate these into mobility services for the user.

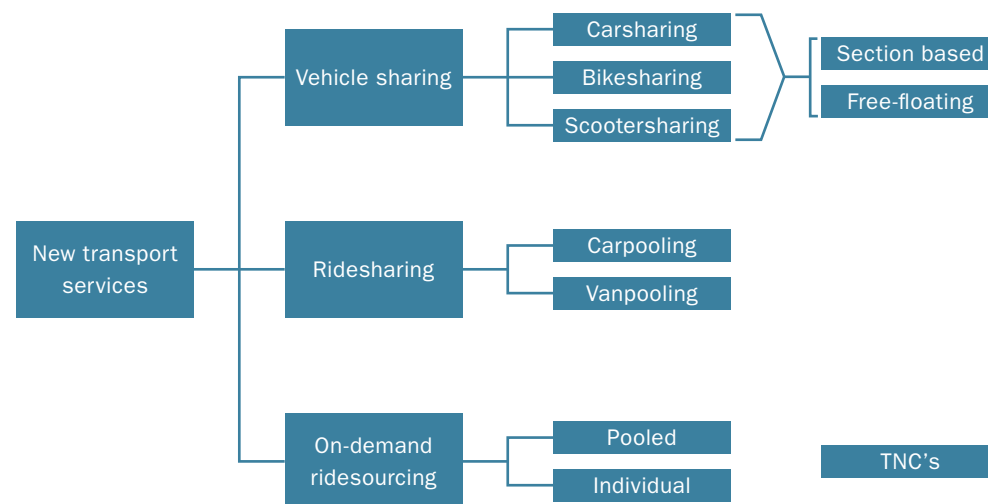


Figure 1 Different forms of new transport services (based on Shaheen et al. 2019; Münzel, 2020)

Goals, motivations and phases of development of MaaS

Various goals and motivations may apply to the implementation of MaaS. For the private sector, MaaS may offer ample business opportunities for new and existing players, as well as opportunities for disruption of the status quo of the mobility market and the field of data. For the public sector, other opportunities may be seen and MaaS services may be an option to tackle some of their issues in mobility, sustainability and urban space.

Different 'levels' of MaaS can be used to characterise the goals and phases of MaaS development, ranging from 'level 0' with no integration to 'level 4' in which MaaS service provision can be steered towards societal goals at a systemic level (Sochor, et al., 2018). Policies and incentives can be used to steer users and providers towards the optimisation of mobility use in terms of societal goals such as sustainability and equity (see Figure 2).

No integration Single, separate services	0
Integration of information Multimodal travel planner, price info	1
Integration of booking & payment Single trip - find, book and pay	2
Integration of the service offer Bundling/subscription, contracts, etc.	3
Integration of societal goals Policies, incentives, etc.	4

Figure 2 Levels of MaaS (Sochor et al., 2018)

1.2 OBJECTIVES OF THE STUDY

1.2.1 Context of the study

The Ministry of Infrastructure and Water Management of the Netherlands (IenW) asked TNO to carry out an independent, comparative case study on the governance of Mobility as a Service (MaaS). This has a focus on a comparable scale (i.e. comparable to the Netherlands in terms of geography/number of inhabitants) through the description and comparison of international case studies and an 'end in mind' of the integration of societal goals (MaaS level 4, see 1.1). The Ministry of IenW would like to take the insights from this comparative study and further develop the Dutch national approach on MaaS following its seven national MaaS pilots, i.e. learning about models of governance (specifically collaboration, standardisation and information exchange) in order to take the next steps.

This study reviews six cases from around the globe. For each case, TNO has conducted desk research and held one or two interviews. More information on the methodology of the case studies can be found in chapter 2. The selected cases are:

- Austria
- Finland
- Île-de-France region (Paris), France
- Los Angeles, USA
- Singapore
- The Netherlands

For reference, an adjacent case has also been studied: MedMij (NL). This case is interesting in the way that they set up a healthcare information platform and standards. This case will, however, not be discussed in the international case study analysis. For more information on this adjacent case, see Appendix 1.

1.2.2 Research objectives

The objective of this study is to gain insights into:

- What is meant by governance and how it could be defined in the context of MaaS.
A Governance Framework is elaborated in order to help solve discrepancies with other stakeholders, to structure discussions and actions and to make sure that aspects are not overlooked.
- The most important challenges in the steering of MaaS (MaaS level 4) at a national level (on a scale comparable to the Netherlands in terms of geography/number of inhabitants) by undertaking a structured analysis of the MaaS governance approaches in the case studies using the case analysis framework created for this study.
- Categories of lessons learnt and best practices regarding policy instruments for steering MaaS at a national level.
- Best practices and lessons learnt in international case studies as a source of inspiration.
- The knowledge base on MaaS models of governance, its shortcomings and future knowledge development suggestions.

1.3 READING GUIDE

In chapter 2, the research design is elaborated. This focuses on the Governance Framework and the methodology of the international case study analysis. Chapter 3 dives into the international case studies. These are described in alphabetical order: Austria, Finland, Île-de-France region, Los Angeles, Singapore and the Netherlands. Next, in chapter 4, we give an overview of the case analyses across the international case studies based on the Governance Framework elements. Finally, chapter 5 gives the lessons learned on the basis of the executed research.

2 RESEARCH DESIGN

2.1 GOVERNANCE FRAMEWORK

For this study, we are particularly interested in the governance and steering approaches of public authorities. Governance refers to choosing, prioritising, directing and steering (Wamsley, 1999 in Hill and Hupe, 2002:13). More general governance is used to solve problems and create opportunities and the structural and processual conditions aimed at doing so (Kooiman, 1999 in Hill and Hupe, 2002:13). If steering is executed by governments, the focus is on policy (and policy instruments), but other stakeholders such as companies and users can also have an active role in steering. For this study, we are particularly interested in the governance in cases that are relevant to Mobility as a Service (MaaS). To which societal goals should the MaaS initiative contribute? What is the steering geared towards (e.g. the number of providers or users of a MaaS service)? How can digitalisation/MaaS enable governments to steer across pillars on new and broader policy goals? Which policy options are applied? How is the pilot/living lab/policy organised? Which stakeholders are involved? What is the context and what are the (local) tasks and challenges? Is a specific policy instrument being tested (for example, an innovative way of purchasing, data sharing standards, etc.)?

TNO has developed a Governance Framework that defines governance through six main categories. This framework is presented in Figure 3.



Figure 3 TNO Governance Framework (TNO, 2020)

The Governance Framework aims to give an overview of what governance entails and to support a structured case analysis. The framework has been specifically developed for the fields of mobility transitions, New Mobility and MaaS. In the framework on the righthand side, three elements are added that can be used to understand the context: the context and culture for the case, the timing of the case and the local drivers and barriers of MaaS.

The core elements of the *Governance Framework* are:

- **Strategy and approach:** This element of the framework focuses on the overall strategy that a (mostly public) institution is taking. For example, is there an overarching integral strategy on MaaS and why was this strategy chosen?
- **Policy and steering:** This element describes how (by what mechanisms) the development and implementation of MaaS is shaped. It concerns the policy and steering instruments that are used. Policy instruments do not only include ‘hard’ regulations but can also be ‘soft’ actions by public actors, such as relationship building, guidelines, letters of intent or information provision.
- **Goals, motivations and desired outcomes:** This element helps to understand the reasons for having or changing governance. This element describes the societal goals and motivations that the public sector steers towards in order to reach the desired outcomes. At the highest level, these can be societal goals, such as sustainability, inclusion or preventing market or government failure, and can range to specific policy goals at lower levels, such as CO₂ targets, etc.
- **Institutions:** This element helps to understand the specifics of how governance is organised and describes the (public) institutions that are involved in the governance of MaaS. The description ranges from the selection and types of institutions involved to the level of concrete sets of rules, laws and procedures (e.g. a decision-making system).
- **Stakeholders and interests (public, private, users):** This element helps to understand the specifics of how governance is organised and describes the stakeholders involved and their interests. It describes which types of stakeholders are involved and which are in the lead (public or private). It further describes the model of roles and responsibilities and if and how cooperation is organised (agreements).
- **Market structure and characteristics:** This element helps to understand the specifics of how governance is organised and describes the market structure and the characteristics of the market for mobility services and the intermediary services in economic terms. The services can be provided by public and private players or in a public-private partnership. The organisation of the market is described through elements at the level of competition and a level playing field as well as through characteristics such as the number of suppliers, consumers and existing (or latent) demand. The market structure can further be described by market segments, target groups for the provided services, price levels and business cases. At the most basic economic level, transactions of data and money and entry and exit rules describe the market structure.

2.2 METHODOLOGY

2.2.1 Approach

The approach consists of three phases:

1. The first phase of the study consisted of establishing the research design. Part of the research design was creating a longlist of cases, determining their learning potential and presenting categories to analyse in each case and case selection criteria. This phase was concluded with a joint workshop by TNO and the Ministry of IenW in which the research design was finalised and the decision was made on the selection of cases.
2. During the second phase, the case study analysis was conducted by doing desk research and interviews. Next, the cases were analysed. This phase was concluded with a joint workshop by TNO and the Ministry of IenW in which the insights were shared and discussed.
3. The third phase consisted of finalising the case analysis, conducting a second series of interviews and collecting more in-depth information on specific elements of the cases. Finally, the results of the research and case studies were reported.

2.2.2 Case selection

For the selection of relevant cases and pilots to study, a broad search was initiated in order to create a longlist of cases from all over the world. The description of these initiatives consisted of the following aspects:

- Name of the initiative (pilot, (research) project, programme)
- Location of the pilot
- Scale of the initiative (on a scale comparable to the Netherlands in terms of geography/number of inhabitants)
- Type of concept tested in pilots; these could be either mobility technologies/MaaS or supporting technologies such as data sharing standards, behaviour change apps, platforms, simulations/models/scenario tools, etc.
- Unique qualities of the case; for instance, a brief description of the approach, types of technologies tested, context or other aspects that are of relevance
- Governance elements (in connection to the framework)

In total, approximately 100 cases were identified in the longlist. Based on the selection criteria and classifications, a shortlist was drafted that consisted of case studies that are relevant to this research. The criteria used for the selection of cases in this research were directed towards cases that focus on MaaS, data and information standards, a comparable scale (i.e. comparable to the Netherlands in terms of geography/number of inhabitants), geographical spread and information availability. The combination of all selection criteria led to the choice of the cases studied while also giving priority to cases that are more mature in the MaaS ecosystem and are therefore related to expected learnings and insights.

2.2.3 Merits and limitations of the study

This study aims to contribute to global discussions and knowledge exchanges on MaaS with a focus on governance, policy and steering. In our opinion, this study has three main merits.

Firstly, this study focuses on the governance of MaaS from a broad and applied scientific perspective. MaaS has been highly touted and advances are highly publicised. Often, governance elements are highlighted in MaaS studies or are studied from a specific perspective or using a (governance) theory. This study aims to explore all of the relevant building blocks for the governance of MaaS. Furthermore, it aims to draw lessons learned from practice, share the latest insights and be a source of inspiration for all pioneers in the MaaS endeavour.

Secondly, this study covers a relatively large number of cases and wide geographical spread. Comparative case studies of MaaS often concern two or three cases. In addition, a wide variety of cases were selected from Europe, the USA and Asia for this research. This selection supports the explorative nature of this study. By selecting MaaS cases with very diverse (governance) contexts, we hope that they collectively (more or less) cover and define the field of governance for MaaS.

Lastly, we created a structured analysis of the governance of MaaS using the TNO Governance Framework in this study. This approach ensured that all cases were analysed from a broad governance perspective and prevented some parts of the MaaS landscape from receiving more focus than others. Furthermore, the Governance Framework was used to structure the interviews as well as the case descriptions (using factsheets) and the cross-case analysis. To conclude, the study aimed for scientific rigor within the project scope (case descriptions include references to all sources used, all interview reports and case descriptions were checked and approved by the interviewees and the report was reviewed by two independent reviewers). All errors, ambiguities and misinterpretations are the responsibility of the authors.

Of course, this study also has limitations. Due to the explorative nature of this study combined with our focus on the latest information, the main sources of information were the interviews supported by desk research on each case. This approach has several limitations regarding exhaustiveness, the absence of biases and the level of detail of the information included.

As a comprehensive literature review on MaaS was outside the scope of this study, the governance elements listed in this study are not exhaustive and elements already listed in literature may be omitted. The desk research aimed to give a first impression of each MaaS case and to prepare the interviews. Therefore this did not result in either a complete or detailed picture. The core of the case interpretation and analysis is based on preparatory desk research, one or two interviews of one hour each and reflection by respondents on the factsheet and case description. Despite tailoring the interview questions on the basis of the desk research, it was challenging to touch base on all elements of the Governance Framework within this limited timeframe. We therefore tried to focus on the key aspects in each case and explicitly asked for additions when interviewees deemed this necessary. This has resulted in a case study in which not all cases (and all case elements) are described at the same level of detail and where there is plenty of inspiration for follow-up research (i.e. on MaaS uptake).

Secondly, the lessons learned should serve as inspiration and, hopefully, instigate discussions and knowledge exchanges between all stakeholders involved. As the case analysis demonstrates – and we tried to do this justice by not only including a factsheet but also a case description – there are many nuances, dynamics and interactions between elements, as well as relative importance for factors that remain unclear or underexposed. Furthermore, it is only possible to assess the effects of key actions to a limited extent. For example, the extent to which the chosen strategy and approach in each case has contributed to the development of the MaaS ecosystem and the degree of uptake needs further research.

This study focused on cases in six different countries. Each case also focused on a geographical scope covering a nation, a region or a city. The focus was therefore at that level, while the lower levels (neighbourhood or city) or higher levels (regional, national or supranational) were not studied. Whether the lessons learned can be relevant for MaaS cases in other countries or initiatives at other scales of government needs to be validated. As the majority of the interviews were conducted with government officials, the perspectives of private parties and (representatives of) users are also underrepresented. The transferability of the lessons learned for governance actions by non-public authorities therefore remains to be seen.

3 CASE STUDIES

3.1 OVERVIEW OF THE CASES

In this chapter, the following cases are discussed:

- Austria
- Finland
- Île-de-France region (Paris), France
- Los Angeles, USA
- Singapore
- The Netherlands

In Table 1, the highlights of the case studies are presented alongside actions connected to the development of MaaS.

Table 1 Highlights of case studies

	Highlights	Developing MaaS
Austria	<ul style="list-style-type: none"> – Successful early MaaS pilot in which 2 MaaS platforms were developed by local and national public transport providers. – Nationally coordinated MaaS program but political change in 2019 put a stop to the program and focus was switched to national public transport ticketing (1-2-3-ticket). – Austria has two MaaS apps that increasingly get more functionality; WienMobil in the Vienna region and Wegfinder at the national level. Both are developed by public transport operators, have a large uptake, yet at this moment they are mainly used for public transport services. – Public Transport is seen as a necessary backbone for MaaS. 	Active role of public sector in setting up/organizing MaaS market. Funding for pilots, facilitating collaboration. Incorporating governance learnings from earlier pilots.
Finland	<ul style="list-style-type: none"> – Finland was among the first actors being very active in the field of MaaS. – Legislation change opened market for private companies to offer mobility services. – Government facilitates network building and provides funding and loans for new service providers and subsidizes mobility service providers in becoming 'MaaS-ready'. – For MaaS in rural Finland pilot projects have been setup, organized in PPPs. The pilots focus on specific parts of a MaaS system (e.g. demand-responsive transport) instead of organizing a fully multi-modal integrated platform. 	Ground rules through legislation change forcing open data but not shaping specific developments (e.g. not setting data standards). Facilitating and investments.

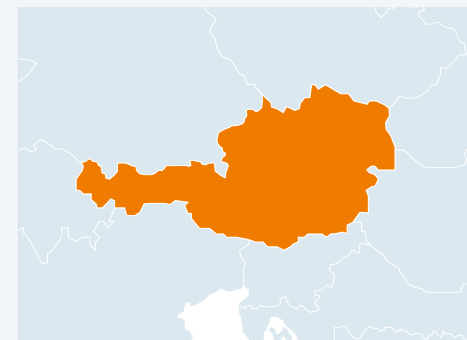
	Highlights	Developing MaaS
Île-de-France region (Paris), France	<ul style="list-style-type: none"> – Government is heavily involved in pilots and R&D in collaboration with private parties. – IDFM have their own MaaS platform (ViaNavigo) – planning, booking, ticketing, and are MaaS app operator. – They set up collaboration between public and private sector parties. 	Many actions, pilots set up by Regional Authority (IDFM). Steer towards private players (having to collaborate with public transport providers and regional authority).
Los Angeles, USA	<ul style="list-style-type: none"> – Public control on data standards called the Mobility Data Specification (MDS). Initiated by LADOT, created and run by the Open Mobility Foundation. Currently used for e-scooters, but will expand to taxis and eventually all shared modes. – Active role in setting data requirements for apps. – Giving room for market parties to develop services. – LADOT is striving to make use of platform business model (comparable to app store), where they set terms and invite others to innovate on the services offered. – LADOT has a long-term vision on steering MaaS towards societal goals, includes MDS, incentive structures and a universal booking system (the last two are in development). 	Public control on data standards. Active role in setting requirements. Room for market parties to develop products
Singapore	<ul style="list-style-type: none"> – No public MaaS specific strategy. strategy mostly focused on enhancing existing public transportation and regulating private vehicle use. – Regulation of mobility takes place per mode, not across modes. Focus is on organizing good access for mass movement, mainly via a public transit backbone. New mobility modes and MaaS are seen as options to strengthen this. Regulation takes place to safeguard commuters interests. – Public transport is dense, affordable and has high mode share. It is seen as backbone for mobility system by the government and MaaS can be an opportunity for first and last mile connections inside the public transport system in further stimulating the efficiency of the PT 	The Smart Mobility vision sets goals that are overarching and do not set specific goals on MaaS. As a result, there also isn't an overarching MaaS program. The government is not targeting at developing/stimulating MaaS in itself as the added value is not clear and specific yet, for instance how it incentivizes use of first and last mile options feeding into the currently well-functioning PT system (in which a lot of public money is invested).

	Highlights	Developing MaaS
The Netherlands	<ul style="list-style-type: none"> – The Netherlands has a large nationwide program for MaaS. The program consists of seven national scalable MaaS pilots starting from different policy goals of the involved regions. – Much effort is paid by the Ministry to building public-private partnerships, level playing field, data sharing and data standards. – Development of a knowledge and learning environment to exchange public-private data for learning. Aim is to steer on policy goals through MaaS (level 4) based on data. 	Many actions, pilots set up by cooperation of public parties and funding from public sector, public parties facilitate collaboration and facilitate growth of private players.

For each case study, a factsheet is presented that gives a quick overview of the case study. The factsheets start with an indication of the context, highlights and timeline, then elaborates on the six categories of the Governance Framework. Next, a schematic overview is given of the key MaaS ingredients and government actions. This shows the most important actions and outcomes. Finally, a narrative is elaborated that brings all of the information together for each case study.



3.2 AUSTRIA



Context

- Nine million inhabitants; 109 people per km².
- Modes: dense, relatively cheap public transport (local and national) with many regular users; shared mobility (cars, bikes, scooters) in larger cities, esp. Vienna. Local and national (find, book, pay) MaaS apps. High deployment in Vienna.
- Starting point: pilot project Smile to develop MaaS system; giving public transport a central role.



Highlights

- Successful early MaaS pilot in which two MaaS platforms were developed by local and national public transport providers.
- Nationally-coordinated MaaS programme but a political change in 2019 put a stop to the programme and the focus was switched to national public transport ticketing (1-2-3 ticket).
- Austria has two MaaS apps that are increasingly acquiring functionalities: WienMobil in the Vienna region and Wegfinder at the national level. Both have been developed by public transport operators and have a large uptake yet are currently mainly used for public transport services.
- Public transport is seen as a necessary backbone for MaaS.



Timeline

- 2014/15 Smile pilot (MaaS app in Vienna)
- 2016 WienerLinien continues with WienMobil app
- 2018 ITS Austria starts working group for MaaS
- 2019 MaaS miA concept published including recommendations for actions
- 2019 MaaS lead projects Domino and Ultimo are granted
- 11/2019 change in government and transportation ministry
- End of MaaS-specific programme MaaS miA
- 2020 start of the development of '1-2-3 ticket' (one ticket for public transport across the entire country) and founding of 'One Mobility' ticket platform with strong focus on ÖBB (national railways) as MaaS platform integrator and on creating a strong public transport-based backbone of the mobility system.



Goals, motivations and desired outcomes

- Service-oriented and inclusive mobility system
- Efficient use of infrastructure and new services
- Integration of services offered by private companies in public transport solutions.
- Safe, efficient and affordable mobility offer.

**Strategy and approach***Before government change*

- Active facilitation of interaction and development of market rules, standards and cooperation between MaaS players.
- Steering towards giving public players (public transport, road authorities, research) a large role.
- Public transport providers (local and national) are seen as MaaS integrators/platform providers.

After government change

- Investing in ÖBB and their (planned) ticket platform 'One Mobility' in order for ÖBB to be able to offer a '1-2-3 ticket' and become a leader in offering mobility for all everywhere in the country.

**Institutions**

- Change in government and leadership at the Ministry (2019) brought large change: the MaaS programme was redirected and the new strategy is not MaaS-specific but is focused on public transport as a strong mobility backbone.
- Current programme supports the 1-2-3 ticket rollout with main role given to ÖBB.
- Establishment of 'One Mobility' for integrated public transport ticketing for the 1-2-3 ticket to take over the ÖBB booking system (organised in separate organisation steered by the Ministry).
- Before, the MaaS miA programme was in place, bringing stakeholders together to cooperate and develop standards. Backend of local MaaS platforms is now run by a spinoff company from the Smile pilot 'Upstream Mobility'.
- The national access point for mobility data (NAP) is maintained by ITS Austria/AustriaTech (subsidiary of the federal Ministry), but data quality varies and meets only the minimum EU standard to a large extent.

**Policy and steering**

- Steering national public transport provider.
- Setting up a ticket company steered by the Ministry.
- Before government change:
 - Piloting and experimenting (including the Smile pilot).
 - Facilitation of the working group and MaaS programme (MaaS miA).

**Stakeholders and interests**

- Ministry of Transport.
- ITS Austria/AustriaTech.
- ÖBB (national railways) and their MaaS app Wegfinder, which integrates services of transport service providers.
- Wiener Linien (public transport provider in Vienna, owned and steered by the municipality) and their MaaS app WienMobil, which integrates the services of transport service providers.
- Other municipalities and regional/local public transport providers.
- New Mobility service providers (car, bike, scooter sharing, TNCs, taxis).

**Market structure and characteristics**

- The MaaS market is based on public transport providers acting as integrators and private companies providing different types of mobility services (sharing services mostly).
- There are competing MaaS apps from ÖBB at the national level (Wegfinder app) and e.g. in Vienna (the successful WienMobil app, also integrating eight operators for carsharing, car hiring, taxis, parking and shared bikes).
- The Ministry had the strategy of developing a MaaS ecosystem and facilitated collaboration between stakeholders in setting up standards and cooperating to deliver a valuable service to consumers.
- Due to a political change, the facilitation of this collaboration has ended and there are conflicts between the national strategy that gives ÖBB a large role and local players.
- The national strategy is not focused on MaaS anymore but exclusively on public transport.
- ÖBB is trying to use their incumbent position and their real estate assets to force transport service providers and local public providers into working with them.

Key MaaS ingredients and government actions in Austria

Figure 4 highlights the key MaaS ingredients and the government actions in Austria. This figure shows the most important actions and outcomes plotted over time (from left to right).

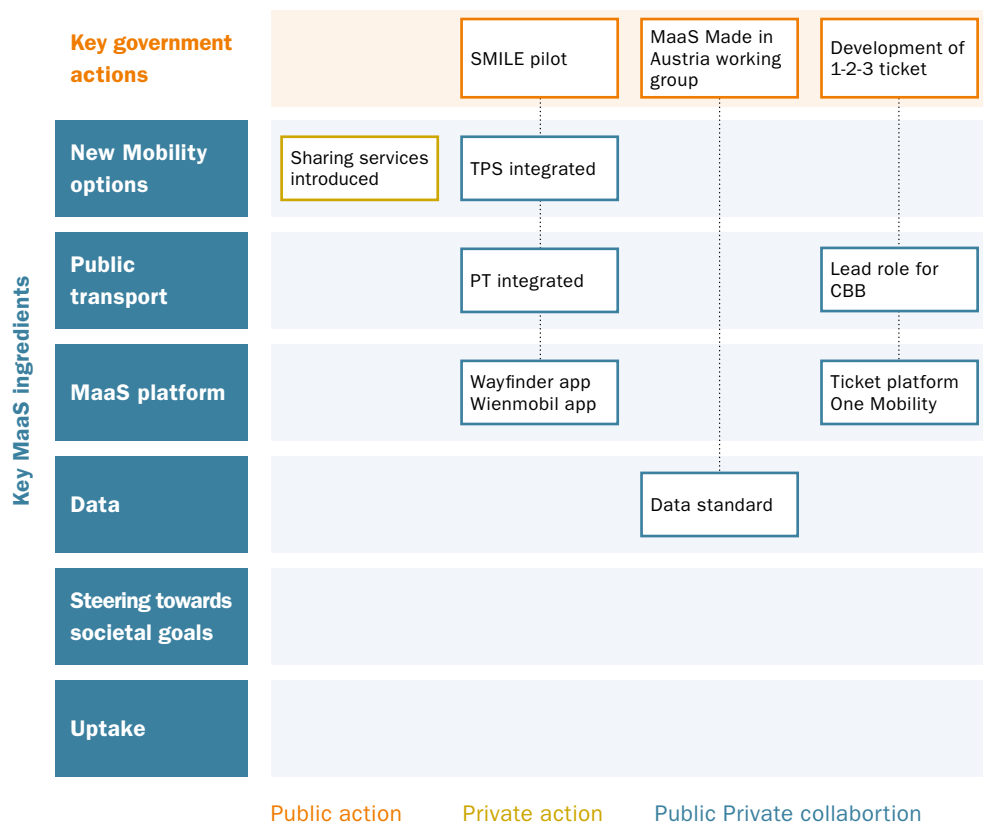


Figure 4 Overview of Austria case: key MaaS ingredients and key government actions

Let us introduce mobility in Austria

The capital, Vienna, is by far the largest city in Austria – 1.9 million people – followed by a limited number of much smaller cities. The Vienna region has the largest share of travellers in the country. The larger part of the country consists of rural areas in which the dominant mode of transport is the car. Car ownership and parking costs in Vienna are high. The public transport system is well-developed, especially in the cities, and affordable for users. The country is known for its scenic and well-developed network of train connections that run like clockwork throughout the entire country. In Vienna, “cycling makes up a significant portion of travel – 7% citywide (Wiener Linien, 2018) – and upwards of 13% in the inner-city districts (MA 18, 2015), which feature separated bike lanes, bike-specific signage and signalling, and ample bike racks” (Moran, Laa and Emberger, 2020).

The rise of new mobility options

The growth of New Mobility Services in Austria followed the European pattern. For example, Car2Go launched in 2011, reported 800 cars in 2014 and claimed to have 70,000 members in Vienna (Gillingwater, 2014). Car2Go was quickly followed by other carsharing companies with various business models (private carsharing, electric cars, station-based and free floating). Carsharing companies also left the market due to fierce competition, struggles with creating a viable business model and a lack of clarity on rules, regulations and responsibilities.

Uber was introduced in 2014 and received an injunction from the Commercial Court of Vienna in 2018 yet was later re-instated. “In 2017, several dockless bikesharing companies launched in Vienna, though several of the largest (Ofo and O-bike) concluded operation following the city’s passing of a more stringent bikeshare regulation (Laa and Emberger, 2019). Specifically, these new rules held operators responsible for removing bicycles that were either obstructing pedestrian walkways or were damaged, with fines levied for those not removed within four hours after a complaint was filed.” (Moran, Laa and Emberger, 2020:1) E-scooters were introduced in Vienna in 2018, followed by regulations at the end of 2018. In 2019, there were six active e-scooter companies (see Figure 5) with a total fleet of 7000 e-scooters (compared to 1500 in San Francisco). The e-scooters have to follow the same regulations as cyclists and are not allowed to drive on the pavements and footpaths (www.wien.gv.at).

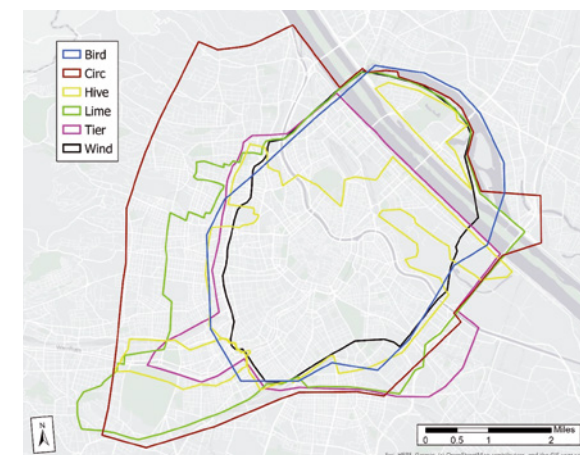


Figure 5 Scooter geofences in Vienna as of August 15, 2019 (Moran, Laa and Emberger, 2020:12)

Vienna as the birthplace of MaaS in Austria

The Austrian MaaS pilot project Smile, which was federally financed, ran from 2011 to 2015 in Vienna. This can be seen as the birthplace of MaaS in Austria. In this pilot, a MaaS platform and an app were developed. The goal of the Smile project was to promote multimodal behaviour, stimulate the use of public transport and lead to less use of private cars. The Smile app offered multimodal route information and integrated planning, booking, ticketing and payment for bikesharing, carsharing, taxis, urban and regional public transit and parking. This enabled users to combine private vehicles, public transport and shared mobility services within a single journey. It involved collaboration between 16 different stakeholders. The project partners included the Viennese public transport provider Wiener Linien, the Austrian national railway

company ÖBB and the following mobility providers: car2go, EMIL, emorail, Taxi 31300, citybike, nextbike, Graz Bike, Twin-City-Liner, WIPARK, e-carage Elbl, Linz Linien, e-mobility Graz, Wien Energie Tanke and Energie Steiermark. The Smile pilot involved collaboration between (major) transport providers and parties such as software engineers and environmental protection organisations. The MaaSFiE research project has studied Smile and evaluated its impact on mobility behaviour. Local government had no leading role during the Smile project; the main actions were done by Wiener Linien and ÖBB while the funding (enabling) role lay with the national authority. After the Smile project's successful finish, two separate MaaS apps entered the market (WienMobil by Wiener Linien and Wegfinder by ÖBB).

Change of government and MaaS course

Before the change of government

What started off with a pilot in Vienna opened up a wider discussion on the potential of MaaS. At the national scale, an initiative of ITS Austria and the Ministry was started in 2018 called 'MaaS made in Austria' (MaaS miA), setting up national framework conditions to realise MaaS in Austria. Until then, there had been no uniform approach to rolling out MaaS in Austria and the objectives of the individual New Mobility service providers also often differed. The aim of the MaaS miA working group was to develop a shared Austrian image of the implementation of Mobility as a Service. "What was important was the joint commitment of all those involved and a technology-independent view in order to be able to create a generally applicable framework," emphasises Martin Böhm, Business Unit Manager at AustriaTech.¹ In the MaaS miA concept publication, the following basic requirements for MaaS were listed: the creation of organisational and legal framework conditions; the technical definition of the interfaces; technical support for setting up new offers and harmonising existing offers; agreements on access rules for MaaS providers; and the creation of a quality seal for end-customer services. An ITS Austria working group defined MaaS miA-Readiness-Levels in order to develop a common understanding. ITS Austria took on a proactive and dynamic role by supporting cities and regions in their efforts to develop pilot projects that efficiently network local mobility offers.

In 2019, ITS Austria set up two leading research projects bringing together key stakeholders around MaaS: ULTIMOB and DOMINO. The projects are funded by the Austrian Ministry of Transport and will run for four years. ULTIMOB tests the integration of MaaS solutions in four pilot regions, analysing technology, users and governance aspects. The DOMINO project aims to set up new services and integrate existing services in three pilot regions according to the MaaS made in Austria framework. In both projects, new offers for MaaS apps are being designed.

After the change of government

In November 2019, there was a change in the national government after a new political coalition took office. The MaaS miA initiative was redirected. The national government decided to focus on the further development and use of the nationwide public transport system. A new programme was set up with the goal of implementing the so-called 1-2-3 ticket. The policy plans are focused on public transport and are not labelled as MaaS. Yet despite a clear change of course by the national government, existing initiatives such as the research projects and the initiatives in the cities continue. The local initiatives seem to be in competition with the national plans.

1 <https://infothek.bmk.gv.at/maas-autonom-vernetz-mobilitaet-punkt-its-austria/>

The 1-2-3 ticket

The idea of the 1-2-3 ticket is to have one ticket for public transport in the entire country and to build up one mobility ticket platform that can integrate different services. 1-2-3 stands for the costs of the ticket: €1 per day for a ticket covering one province, €2 for three provinces and €3 for a ticket covering the whole country. This 'climate ticket' should be the car key of the future and incentivise people to use alternatives to the private car.

Market structure for MaaS

The evolutionary approach of MaaS in Austria has led to a market structure in which there are multiple MaaS apps, the most well-known being the WienMobil app by Wiener Linien and the Wegfinder app by ÖBB. It was unforeseen that the Smile pilot project would lead to apps by ÖBB and Wiener Linien that compete with each other. Both apps have high numbers of users: Wienmobil has been downloaded more than a million times and has around 150,000 active users; Wegfinder has been downloaded more than 700,000 times. The large majority of the users use these apps to find, book and pay for public transportation. In both apps, multiple New Mobility Services are integrated alongside public transport providers: carsharing, bikesha- ring, scootersha- ring, stand-up scootersha- ring, car rental and taxis.² The evolutionary approach is illustrated by the fact that it all started with one app in which the services of two public transport providers and several New Mobility companies were integrated in a MaaS platform, followed by the rolling out of apps in other cities and the integration of other providers. A key role in this process was played by Upstream Mobility, which developed the technology, data connections and the platform and is a subsidiary of Wiener Linien and the Viennese city services. There was no standardisation of APIs and data; the company Upstream Mobility was responsible for building it and they "simply built it." The business model of Upstream Mobility consists of offering the development of apps, platforms and MaaS services (such as finding, booking and payment integrations) and is extended with data analysis offerings for cities.

The platform is open to every service provider that would like to join. Anyone who wants to plug in the platform can do so. A third party, such as a MaaS operator with its own app, can use the platform for information and booking using APIs and has to pay a fee, whereas third parties like New Mobility service providers get non-discriminatory access and do not have to pay a fee. Upstream Mobility's customers are public transport companies (who initiated the MaaS app developments in Austria), New Mobility service providers and governments. The new government is now investing their effort into setting up a nationwide ticketing system for public transport.

2 WienMobil integrates the following transportation service providers: Citybike Wien Bikesha- ring, Europcar Rental Cars, Nextbike Bikesha- ring, ÖAMTC easy way E-Moped Sharing, ÖBB Rail&Drive: Stationäres Carsha- ring, SHARE NOW Carsha- ring, Sixt Rental Cars, Taxi 31300, Taxi 40100, TIER E-Scooter Sharing, Westbahn, WiPark. Wegfinder integrates the following transportation service providers: e-step-scooter: bird, KiWiRide, TIER; bikesha- ring: Citybike, Nextbike; Carsha- ring: Share Now, ÖBB Rail&Drive, Caruso Network, floMOBIL, FAMILY OF POWER, sharetoo, MO.Point, Getaround; Rental cars: Europcar, Sixt, Hertz, Avis, Budget, Alamo, Thrifty, Denz Megadrive, Buchbinder; Scootersha- ring: emmy, ÖAMTC easyway; Taxi: Taxi 40100, Taxi 31300, Anrufsammeltaxi, Uber; Parking: EV charging

MaaS uptake

MaaS apps have a large user base as they started off as the dominant public transport apps. However, these apps are still largely used for public transport services only. The challenge for the further development of MaaS in Austria is to familiarise more and more users with the concept of MaaS, New Mobility Services and the potential of MaaS as an alternative to private car ownership. The change of government has altered the MaaS strategy, yet developments on key MaaS ingredients continue at both a national scale (the 1-2-3 ticket for public transport) and a local scale with the promotion of New Mobility Services through MaaS apps in the main cities. Public transport was and is seen as the key MaaS ingredient. The focus on public transport integration at a national level therefore has the effect of creating a clear role for public transport companies. This could potentially be an important building block towards the large-scale deployment of MaaS in Austria.



3.3 FINLAND



Context

- 5.5 million inhabitants. 16 people per km² (most inhabitants in largest cities in the south; 1.5 million in Greater Helsinki Metropolitan Area).
- Modes: public transport, some sharing modes in largest cities. MaaS (find, book, pay) available, small uptake.
- Starting point: modernising the mobility system and initiating new services.



Highlights

- Finland was among the first high-activity actors in the field of MaaS.
- A legislation change opened up markets for private companies to offer mobility services.
- The national government facilitates network building, provides funding and loans for new service providers and subsidises mobility service providers when becoming MaaS-ready.
- MaaS initiatives focus primarily on the Helsinki region. Pilot projects have been set up for MaaS in rural Finland, organised into PPPs. The pilots focus on specific parts of a MaaS system (e.g. demand-responsive transport) instead of organising a fully multimodal integrated platform.



Timeline

- 2009 Finland's first national strategy for ITS
- 2012 'New Transport Policy Club' formed by the Minister of Transport to discuss the modernisation of transport legislation. The term MaaS is first mentioned here
- 2015 MaaS Finland (later MaaS Global) is founded
- Since 2015, multiple pilot projects (PPPs) on starting integrated mobility services in rural Finland have taken place
- 2016 Business Finland invests in the development of MaaS Finland's Whim app (€2.2 million)
- 2016 First Whim ride (offered by MaaS Global)
- 2017-2019 New Act on Transport Services establishing the modernisation of transport legislation (took effect gradually)



Goals, motivations and desired outcomes

- Building a modern, efficient, sustainable, accessible and user-focused mobility system.
- A well-connected multimodal transport system.
- Facilitating new businesses and business models.



Strategy and approach

- The government's vision spans all modes and is geared towards an integrated, user-centric multimodal mobility system.
- Developing base conditions through legislation that enable market development and digitisation.
- Ground rules laid out by a legislation change are forcing open data and interoperability of payment and ticketing systems as well as access to these. Specific developments are not shaped by legislation but a decentralised approach is followed. The Ministry is not setting technical rules; the transport agency is developing guidelines and technical specifications in cooperation with stakeholders.
- Public parties are not offering MaaS services themselves. In Helsinki in particular, but also in other bigger cities, the public transport provider is starting to integrate offers (e.g. bikesharing and multiple public transit modes).



Institutions

- Ministry of Transport and Communications
- Sets new legislation (designed in cooperation with stakeholders) and facilitates network building. Ministry does not take a direct role and does not set technical specifications but rather lets market players fill specific standards and market development.
- Organisation structure of the Ministry has previously undergone reorganisation. Getting rid of silos for each mode and combination of transport with communications leads to an overarching perspective on modernising the mobility system.
- Traficom, Transport and Communications Agency
- Implements rules and checks compliance of market players with regulations. Facilitates stakeholder networks.
- Hosts the National Access Point for data sharing.



Policy and steering

- Legislation change: New Act on Transport Services
- Facilitation of interaction and collaboration between stakeholders.
- Funding for New Mobility service organisations by Business Finland through several programmes and instruments (e.g. €2-3 million innovation fund to support the exploitation of the emerging MaaS market. Investment of €2.2 million in the development of Whim app; subordinated debt for Kyyti for platform and ecosystem development).
- Nationally and locally financed pilot projects on New Mobility options.



Stakeholders and interests

- Ministry of Transport and Communications
- Traficom, Transport and Communications Agency
- ITS Finland
- Business Finland
- Helsinki Business Hub
- MaaS platform providers: MaaS Global, Kyyti Group
- (Large) municipalities
- New Mobility service providers
- Public transport providers



Market structure and characteristics

- The Ministry tries to facilitate cooperation and forces open data but expects private players to take up the role of MaaS operator. The government does not take an active steering role in shaping the market.
- MaaS apps offered by private players. MaaS Global is the largest player that offers a private app in the Helsinki region and in the city of Turku. Kyyti Group offers a B2B white label MaaS platform.

Key MaaS ingredients and government actions in Finland

Figure 6 highlights the key MaaS ingredients and government actions in Finland. This figure shows the most important actions and outcomes plotted over time (from left to right).

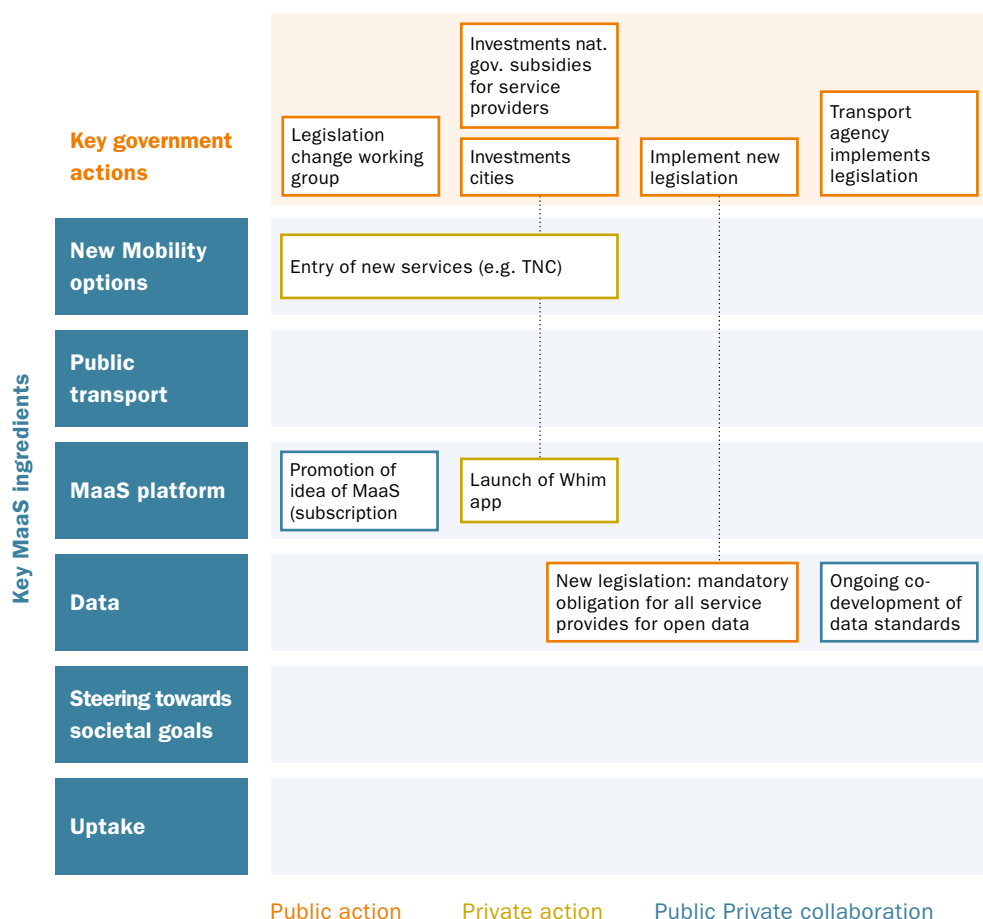


Figure 6 Overview of Finland case: key MaaS ingredients and key government actions

Mobility in Finland

Finland has a few major cities. The capital, Helsinki, is the largest with 650,000 inhabitants, followed by four cities that are half to one-third of the size of the capital. The main MaaS developments take place predominantly in these cities, although the discussion on the potential of MaaS in rural areas has been active as well since 2015. Finland has a well-organised and affordable public transportation system and has invested in an elaborate bike infrastructure over the past decades. The general development of the transport system of Finland and the uptake of shared mobility in the cities are shaped by the focus on sustainability and reducing car dependency.

First mover of MaaS

Finland was one of the first movers in the field of Mobility as a Service (MaaS) in the world and has become very active in this. The Finnish government was one of the earliest to formulate a vision on MaaS and set up larger-scale policy changes to accommodate New Mobility Services and a funding strategy for MaaS pilot projects. The approach is a combination of changes in regulations, new policies, growth funding and providing loans, funding for pilot projects, setting up public-private partnerships (PPPs) and integrating MaaS into the larger transport policy context.

Conceptualisation of MaaS

In 2012, the Ministry of Transport formed a 'New Transport Policy Club' to initiate a broad stakeholder discussion on the modernisation of the transport system. The term MaaS is first mentioned here. In 2015, the government decided on legislative reform. Finnish legislation at that time was rather strict compared to other European countries in respect to access to the road transport market, the taxi sector and combining services, which made the legislation an entry barrier for new companies and mobility services. The national government wanted to change this legislation as part of a strategy to enable the digitalisation of the transport system and move towards facilitating the development of innovative services, including MaaS. They see MaaS as an opportunity to contribute to a modern, efficient, sustainable, accessible and user-focused mobility system. The government's vision spans all modes and is geared towards an integrated, multimodal mobility system. New legislation enabling New Mobility Services and interoperability was seen as a possibility for enabling new business opportunities. In addition to enabling new services and business development, MaaS was also seen as a lever to attract foreign investments for Finnish companies and foster export activities. A key element of this vision was having a well-connected multimodal transport system in which private companies can offer New Mobility Services, with a major role for Finnish companies in Finland and abroad. MaaS is promoted not only by the national government but by other stakeholders such as ITS Finland.

Comprehensive legislative process

The legislative process is a core element of MaaS development in Finland. The aim of the legislative change was ambitious; it had to remove barriers to market entry as well as force private companies and public transport providers towards open data and access to/interoperability of ticketing and payment systems. It took five years to develop and establish the Act on Transport Services, which was initiated in 2015 and entered into force gradually between 2017 and 2019. This process gathered momentum to bring together a large number of stakeholders and created a lasting and continuous conversation. This concerned not only public and private interactions but also interactions between ministries, agencies and local, regional and national governments. The process was boosted by consultations and information targeted at a wide range of stakeholders in order to explain the need for the legislative change and establish a shared understanding, feeling of urgency, view on the potential of MaaS and broad support. The actual implementation of the new legislation falls under the responsibility of the Transport and Communications Agency, Traficom, while the continued discussions with transportation service providers and other stakeholders on data sharing guidelines and technical specifications lies with them.

MaaS Global

Initial funding for the development of MaaS was provided by launching a joint programme of the Ministry and the Finnish Funding Agency for Innovation (TEKES, now called Business Finland) in early 2015. TEKES, the economic development arm of the Finnish government, invested around €2-3 million from their innovation fund to support the exploitation of the emerging MaaS market. The programme for MaaS aimed to support Finnish MaaS-related ventures in attracting international investors and developing global business opportunities. MaaS Global is the best-known example of a Finnish start-up company promoting the MaaS concept. The Finnish government provided funding for MaaS service development directly and indirectly via promotion and marketing activities. MaaS Global develops integrated MaaS services via their own platform (find, book, pay) with a unique emphasis on subscription-based multimodal mobility packages. This idea was first promoted at a Ministry working group event in 2012 by Sampo Hietanen, then the CEO of ITS Finland and who later became CEO of MaaS Finland Oy, subsequently MaaS Global Oy. MaaS Global has developed its own MaaS platform and app called the Whim app. When MaaS Global was formed in 2016, TEKES (Business Finland) invested €2.2 million in the partnership with two private companies in order to begin the development of the Whim application, one the world's first MaaS provision platforms. This triggered a further €24 million investment in MaaS Global from major investors such as Transdev, Toyota and Karsan. In June 2016, MaaS Global test launched Whim in Helsinki. This app is undergoing further development and is being used in the Helsinki area and several other cities. The active government involvement (financial support via TEKES/Business Finland and the communication of the Ministry and ITS Finland) helped to put MaaS Global and its Whim app on the global stage.

Role of public transport operators

Public transport operators have been less active in the development of MaaS in Finland even though they participated in the preparation of the Act on Transport Services and are taking part in the authorities' stakeholder meetings. The responsibility for public transport (including subsidies) rests at either the state or municipal level. Single tickets are not subsidised and each municipality has the responsibility for subsidising its 'own' residents' public transport passes. Also, the fact that some Public Transport Authorities (PTAs) do not allow third-party ticket resales is seen as a major obstacle to MaaS. It has been suggested that the reluctance of some PTAs on the ticket resale issue is primarily related to a protectionist mindset, risk aversion and organisational inertia. Despite the legal requirement to open up data, public transport providers are not yet financially sanctioned when they do not (fully) comply with this rule. Notably, not all representatives of the public transport sector are active amongst the group of Finnish MaaS stakeholders and the sector has had less active involvement in the preparation of the Act on Transport Services and the creation of the national MaaS vision. However, some local providers are very active, e.g. the city of Turku, which has been developing and applying a MaaS readiness level indicator in a Civitas initiative.

Integration anchored in institutions

A unique aspect of the Finnish institutional structure is that communications and transport are governed by the same ministry (MTC). This has enabled the Finnish government to make structural links between transport and communications policy and bring knowledge on the development of the telecommunications world into the transport world, leading to an overarching perspective on modernising the mobility system. The transport sector is considered important to economic development through the development of New Mobility Services and

MaaS. This has established relations between the Ministry of Transport and Communications and the Ministry of Employment. Another unique characteristic is that this Ministry is not organised into departments according to transport modes (i.e. silos for road transport, public transport, etc.) but rather according to work fields: data, networks, services and ministerial governance. This results in an integrated approach to multimodal mobility. The integral approach to achieving societal goals therefore seems anchored in the institutional structure.

MaaS uptake

Despite Finland being the first mover for MaaS, they cannot be considered a global frontrunner at this moment due to the MaaS uptake. The largest app is Whim and its use (centred in the largest cities, as in many other countries) has had a rather limited uptake. The Finnish case shows that establishing the basic conditions, such as the removal of barriers to market entry and the requirement to share data, are necessary MaaS ingredients but are not sufficient in and of themselves. The further maturing of MaaS in Finland requires the further development of trust between public and private parties, figuring out the roles and responsibilities of all MaaS ecosystem players and working towards functioning data sharing in practice. The Finnish case shows that the development of MaaS in the context of shaping the entire MaaS ecosystem takes effort, long-lasting dedication and patience.



3.4 ÎLE-DE-FRANCE REGION (PARIS), FRANCE



Context

- 12.2 million inhabitants (almost 20% of French population); 1016 inhabitants/km² (Paris: 20,755 inhabitants/km²)
- Modes: dense public transport system, shared mobility (carsharing, pooling, bikesharing). MaaS app of the regional transport authority (finding, booking, payment, many options).
- Starting point: developing, organising and steering the market.



Highlights

- The government is heavily involved in pilots and R&D in collaboration with private parties.
- Île-de-France Mobilités (IDFM), the regional transport authority, has its own MaaS platform and app (ViaNavigo) which provides planning, booking and ticketing.
- IDFM has set up collaboration between public and private sector parties.



Timeline

- 2007: Launch of Vélib in Paris (docked bicycle sharing)
- 2015: One price fits all using Navigo (public transport card of IDFM)
- 2016/2017: Launch of Smart Mobility Programme
- 2018: ViaNavigo app launches; multimodal planning for PT, bike and carpooling
- Ongoing: several R&D projects and pilots for developments towards MaaS
- 2020: ViaNavigoLab and MaaS pilots with developments towards fully integrated MaaS applications, to be integrated with the ViaNavigo/Île-de-France Mobilités app
- 2021: fully integrated regional platform (development of ticketing, operator integration, open distribution)



Goals, motivations and desired outcomes

- Reduction in greenhouse gases (20% by 2020).
- Growth in overall travel (7% by 2020).
- Growth in public transport trips made (20% up until 2020) in order to achieve GHG reduction.
- Growth in active mode trips (walking and cycling).
- Decrease in trips by car and motorised two-wheelers.
- Improved services for travellers with a seamless and personalised experience.
- Improved customer and user insights and knowledge to better guide public mobility policies.
- Promote innovation for sustainable and inclusive mobility.



Strategy and approach

Île-de-France Mobilités is the local (public) transport authority. It is a (financially and administratively) autonomous public establishment tasked with the coordination and control of mobility operations across the entire region of Île-de-France. They are involved in or are the instigator of several R&D projects and pilots. Their approach to MaaS is based on three pillars: 1) playing its full role as a mobility authority (by clarifying relations between actors and disseminating good practices), 2) being a MaaS App operator (offering digital services to travellers) and 3) being the owner of a MaaS platform (for businesses and communities offering data and services for re-users) in order to be able to steer public goals.



Institutions

- Île-de-France (region).
- Île-de-France Mobilités (the regional transport authority), in charge of mobility issues and designing/organising/financing public transit; focused on every mode of transport but also on everything around this such as New Mobility Services, travel information and planning.
- Municipalities in the Île-de-France region are in charge of local policies and local roads.
- National government, Loi d'orientation des mobilités (French Mobility Bill).



Policy and steering

- Île-de-France (region): Le Plan de Déplacements Urbains D'Île-de-France (PDUIF): for all modes of travel, this sets the objectives and framework of the travel policy for people and goods in the regional territory until 2020.
- National government, Loi d'orientation des Mobilités (Loi LOM): opening up the mobility market as much as possible with some safeguard measures to avoid jeopardising public policy (agreements on ticket price, fair and non-discriminant competition, data sharing with the public mobility authority and personal data management plans in line with the GDPR).
- Île-de-France Mobilités, Guide de Référence pour la mobilité servicielle en Île-de-France: in order to organise the complex ecosystem and spread good practices, Île-de-France Mobilités has decided to build a reference guide on key subjects based on consultation with stakeholders. This document includes agreements on mobility offers, media and travellers' information, innovation, data & services, pricing & distribution and governance of collaboration.



Stakeholders and interests

- National government (mobility bill and other transport regulations).
- Region of Île-de-France.
- Île-de-France Mobilités: local transport authority.
- City of Paris and other municipalities in the region.
- RATP (Régie Autonome des Transports Parisiens): administrator/exploiter of the Paris metro, bus, tram and two RER lines. Not all lines are under their control. RATP collaborates with IDFM on a MaaS (Mobility as an Experience) application pilot.
- Transdev: partner of RATP since 2002. International operating public transport company.
- SNCF (Société Nationale des Chemins de fer Français): French national railway company.
- Other (New) Mobility providers.



Market structure and characteristics

- IDFM wants to structure the mobility market in Île-de-France and implement MaaS. The MaaS app, to be developed by IDFM, aims to integrate planning, booking and payment.
- IDFM makes use of pilot projects to develop their service proposition and collaborations with private players.
- Private players and public transport operators cooperate with IDFM in their pilot projects.

Key MaaS ingredients and government actions in Île-de-France

Figure 7 highlights the key MaaS ingredients and government actions in Île-de-France. This figure shows the most important actions and outcomes plotted over time (from left to right).

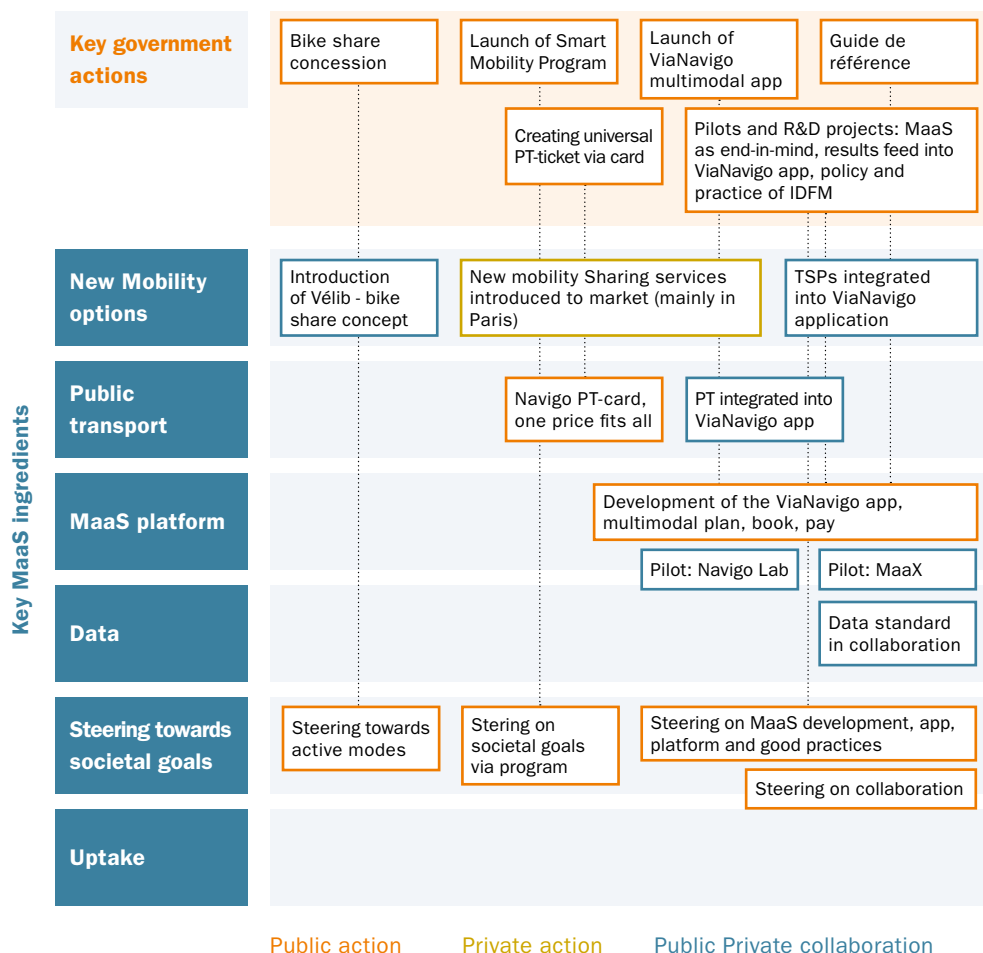


Figure 7 Overview of Île-de-France case: key MaaS ingredients and key government actions.

Let us introduce mobility in Île-de-France (larger Paris region)

Île-de-France is the region that encompasses the city of Paris (among others) and houses almost 20% of the French population – 12.2 million inhabitants. An interesting aspect within the scope of MaaS is that this region also houses almost 50% of French travellers. The city of Paris is densely populated (20,755 inhabitants/km²) and becomes less dense towards the outskirts and other municipalities. In the Île-de-France region – and especially Paris – mobility goals are focused (among other things) on active modes: promoting cycling and walking. Paris can be seen as one of the frontrunners in terms of bikesharing, having started with the bikeshare initiative Vélib in 2007, nowadays commonly known amongst residents as well as

tourists as a means of getting around the city. However, when put to the test during the public transport strikes in Paris in late 2019 and early 2020, the bikesharing initiative cracked under the pressure. The mayor of Paris since 2014 (re-elected in 2020), Anne Hidalgo, has further added to the achievement of sustainability goals by investing in active mode infrastructure (removing 72% (60,000) of parking spaces, adding 1000 km of additional bike lanes). This is part of the mission to redesign Paris according to the 15-minute neighbourhoods principle. In these neighbourhoods, all essential services and activities are within a 15-minute radius by bike or foot – really focusing on 'hypermobility'.

The rise of New Mobility options and MaaS

Vélib was introduced to the streets of Paris in 2007 as a result of a bikesharing concession that the Paris municipality set out to attract shared initiatives to the city in order to offer alternatives to cars and public transportation. The concession was renewed in 2017, when a new consortium – Smovengo – became the 'second generation' of Vélib. This second run had more issues than the first one (by JCDecaux). The Paris shared bike system was severely tested in January 2020 during the seven weeks of public transport strikes and could not live up to users' expectations, clearly showing room for improvement in terms of reliability, supply and repairs to damaged bikes.

Since the first bikesharing concession in 2007, the landscape has changed drastically through the arrival of e-scooters, shared cars and bikes, carpooling and Uber or other ride-hailing concepts. The city of Paris was especially overwhelmed by the number of e-scooters that were dropped onto their streets – over 20,000 in 2019 (among the largest volumes of e-scooters in Europe). This caused a lot of chaos on the streets, e-scooters being dumped in the Seine and unsafe traffic situations. In reaction to this, the city put regulations in place which cap the speed limits of e-scooters, prohibit them from riding on the pavement (exceptions in designated areas) and stimulate driving on cycle paths, among other things. As far as regulating mobility goes, the city of Paris is responsible for everything that concerns public space – they therefore regulate e-scooters or where to place bus stops – whereas Île-de-France Mobilités (IDFM), the regional appointed transport authority, is responsible for (public) transport services and infrastructure.

IDFM is a (financially and administratively) autonomous public establishment tasked with the coordination and control of mobility operations in the entire region of Île-de-France. In 2015, IDFM launched the Navigo pass, a public transport card offering one-price-fits-all integration with all public transport modes in the region. Later, in 2018, the ViaNavigo app launched, through which multimodal planning for public transport, shared bikes and carpooling was integrated. ViaNavigo is currently being developed further towards a real MaaS app and corresponding platform with integrated planning, booking and payment and the integration of all modes of transport (public transport, bicycles, e-scooters, e-mopeds, carpooling, carsharing, taxis and VTC, which are chauffeur services that are not taxis, like Uber). The app also includes information on mobility services (bike repairs, toilets, WiFi, etc). This is a dematerialised transportation document and a real-time route calculator which is customisable (adding favourite destinations, journey mode options, etc.) and highlights soft mode transport options (showing cycling routes proposed for each journey and carsharing proposals). The Vianavigo app will undergo a name change to "Île-de-France Mobilités" in late 2020 or early 2021.

“Putting the Navigo pass on a smartphone is only one step. Our 2020 strategy for new digital services is to offer an “Île-de-France Mobilités” application that will be the true passport for mobility in Île-de-France. This route calculator will make life easier for people in Île-de-France by allowing them to buy a wide range of mobility services online. It will also be an indispensable tool to fight against pollution by reducing personal car use.”

Valérie Péresse, President of Île-de-France Mobilités, President of the Île-de-France Region (POLIS network, 2019)

MaaS as means to achieving regional goals

The Île-de-France region and the city of Paris have ambitious goals when it comes to mobility. They aim for a 20% reduction in greenhouse gases (by 2020), a 20% growth of public transport trips as opposed to carbon-emitting trips (by 2020) and a growth in active modes trips. They also want to decrease trips by car and motorised two-wheelers, improve services to travellers with a seamless and personal experience, offer the customer insights and knowledge to better guide public mobility policies and promote innovation for sustainable and inclusive mobility.

MaaS is seen by IDFM as a key lever to achieving the regional (and local to Paris) goals and strategic objectives, and they have had a Smart Mobility programme in place since 2016. In regard to MaaS, IDFM's policy is based around three main pillars: 1) playing its full role as a mobility authority (by clarifying relations between actors and disseminating good practices), 2) being a MaaS app operator (offering digital services to travellers) and 3) being the owner of a MaaS platform (for businesses and communities offering data and services for re-users). A fourth element which is essential in achieving these regional goals is regulation. Providing the ecosystem with a platform which is optional and non-mandatory in order to be used by all operators and building a framework on how all of these elements work together is seen as an important task by IDFM. This calls for formalisation regarding how to collaborate, which has been taken up in the ‘Guide de référence’, a reference guide on how to collaborate with all ecosystem parties: travellers, MaaS actors (both IDFM and other MaaS providers, including public and private platforms) and data providers (public transport operators, New Mobility operators and local community operators). The reference guide includes agreements, permits and conventions with local authorities, details on data and service provision and contracts and conventions with IDFM.

Smart Mobility programme with MaaS as a starting point

In 2016, IDFM launched its Smart Mobility Programme with MaaS as a starting point. Since then, they have started working on acquiring knowledge, participating in R&D projects and building and testing their own MaaS app with a very clear end goal in mind: an integrated regional MaaS platform that serves as a means of achieving regional goals and the strategic objectives of IDFM. To do this, they collaborated with both public and private parties in several projects of which the results all feed into the IDFM MaaS concept. Some of these R&D and knowledge projects include:

- M2i: Integrated Mobility in Île-de-France – developing a top-quality traveller information service. This includes new data, enrichment of the IDFM Mobility Portal and unique services (e.g. predictive multimodal GPS, mobility tips). Partners involved: Transdev, Cityway, Autoroutes Traffic, Engie Ineo, Phoenix-ISI, Spie, Liris, Lyon 1, PSA Groupe, Renault.

- IVA: Augmented Traveller Information. This project has four aims: predictive indicators for transport networks, a route calculator including predictive indicators, a mobile application based on AI and behavioural studies & crowd simulation. Partners involved: IFSTTAR, Kisio, SNCF, SPIROPS.
- Île-de-France Mobilités Start-up Challenge, “Challenge innovation on traveller information”: this aims to provide users with concrete solutions, raise awareness of innovations in mobility, keep pace with innovation and work hand in hand with start-ups. The 2019 challenge resulted in four winners: GeoTwin (suggestions for alternative routes, taking into account risks of bottlenecks), Nextérité (information assembled from texts sent by travellers), uppli.fr (offering a platform for alternatives to sharing taxis or mini-cabs) and Faciligo (a social network through which people with limited mobility can find help travelling).
- PRIM (Regional Information Platform for Mobility): this aims to develop and centralise information for travellers. They also use crowdsourcing and aim to include public and private data and services for route planning and predictive information. This is in order to provide data to both IDFM programmes and other service providers/client companies/local authorities (e.g. Google Maps, SNCF, Citymapper).

There are also projects (some still ongoing) that specifically focus on platform and app development. The input and results from these projects feed directly into the ViaNavigo/Île-de-France Mobilités app and IDFM aims to offer the most complete MaaS possible. The following projects should therefore be mentioned:

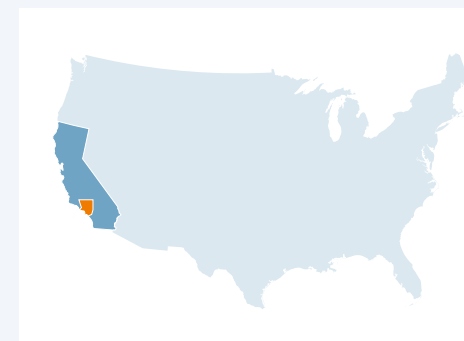
- **Smart Navigo Project:** a project to find a smart ticketing solution that is now integrated into the ViaNavigo app. This was done with the following partners: Thales, Dejamobile and Wizway Solutions.
- **Navigo Lab:** this is an app, also owned by IDFM, that is currently testing new and innovative services with 8000 test subjects. The aim is to optimise journeys and offer suggestions of best routes to travel intermodally. A user community is also integrated into the app with active participation, trip feedback options, delay reports and disruption, cleanliness & attendance issues. More than 80 transport operators are also integrated: metros, buses, trams, transilien (suburb train), RER, Uber, Kapten, carpooling (Karos, Klaxit, Blablalines), bicycles, e-mopeds and e-scooters (Vélib, Cristolib, SEE, Velo2, Bicloo, Cityscoot, Bird, Lime).
- **MaaS:** MaaS is a collaboration between IDFM and RATP on Mobility as an Experience with 2000 test subjects over the course of six months. The goal is to integrate all transport modes, dematerialised ticketing, route planning and calculation, with user experience as the central element. The partners involved (besides RATP and IDFM) are Cityscoot, Communauto, Donkey Republic, Dott, Kapten, Claxit, Marcel, Vélib, VOi and Zenpark.

MaaS uptake

An interesting aspect of the Île-de-France case is that the regional transport authority, IDFM, works towards the strong end goal of a regional integrated MaaS platform and app while it is already running business. This is ambitious in terms of both MaaS and working towards a strong brand for Île-de-France Mobilités. MaaS is a 'running business' for IDFM, with 1.5 million unique app users per month. They keep on improving their app based on insights from pilots, research and R&D projects that they are involved in. This is not just a separate programme. They allow a lot of room for experimentation and learning within the organisation when it comes to MaaS. They utilise an evolutionary approach by using the existing ViaNavigo app as the central MaaS app, which has both advantages (they do not need to start from scratch and already have a large user base) and disadvantages (this is based on an older platform and technology; questioning themselves on whether a public party is best for the development and maintenance of such an app). In 2020, the app is still mostly used for public transportation and walking routes (95%). Currently, the application includes four modal solutions: public transport (80 public transport operators are included), carpooling (five transport operators), bike routes and bike sharing (three public operators) and walking routes. In 2021, the roadmap will also integrate carsharing, cabs and ride-hailing and car parking (integrating park and ride).



3.5 LOS ANGELES, USA



Context

- 3.98 million inhabitants; 3278 inhabitants/km².
- Modes: limited but growing public transport system with small market share, large market share for TNCs, growing scooter sharing, small growth of bike and car-sharing. No MaaS app, some New Mobility service providers offer multiple services in their own app (walled gardens).
- Starting point: steering the new and growing mobility modes towards the achievement of societal goals.



Highlights

- Public control of data standards is called the Mobility Data Specification (MDS). Initiated by LADOT, created and run by the Open Mobility Foundation. Currently used for e-scooters but will expand to taxis and eventually all shared modes.
- Active role in setting data requirements for apps. Giving room for market parties to develop services.
- LADOT is striving to make use of a platform business model (comparable to an app store) in which they set terms and invite others to innovate on the services offered.
- LADOT has a long-term vision on steering MaaS towards societal goals and includes MDS, incentive structures and a universal booking system (the last two are in development and the latter is stalled due to COVID).



Timeline

- 2008: TAP (public transport payment card) introduced by LA Metro
- 2012: TNCs arrive
- 2017: 51% decline in taxi use due to TNC growth
- 2018: LADOT initiates planning process to determine regulatory framework for shared mobility
- 2018: LADOT releases first version of MDS and first companies start using it
- 2018: Dockless e-scooters and bikes rise in popularity
- 2019: LADOT taxi and for-hire-vehicle study (effects on transport) published
- 2020: Public transport app becomes LA Metro's official app



Goals, motivations and desired outcomes

- Accessible, equitable and sustainable mobility.
- “Provide world-class transportation system that enhances quality of life” – increasing prosperity, removing mobility barriers, high-quality mobility.
- Reacting to market disruption in order to create a level playing field and limit the negative impacts of shared mobility.



Strategy and approach

Both LA Metro (Los Angeles County Metropolitan Transportation Authority) and LADOT (Los Angeles Department of Transportation – city level) are finding ways to strive towards their public goals. An important part of this approach is the MDS (Mobility Data Specifications) developed in LA (which initialised the establishment of the Open Mobility Foundation). MDS defines data standards and sets data sharing requirements between private companies and the government. Public authorities take an active role in setting up rules, requirements and standards, whereas the applications themselves are delivered by market parties without further interference from the public side. TNCs are largely regulated at a state level with a limited role for the city itself. LADOT planned for a Universal Booking System, their own MaaS platform. This development was stalled due to lack of financial resources because of the impact of COVID. LADOT also develops incentive structures to steer MaaS towards societal goals – this has been partially used with e-scooters but has not yet been widely implemented.



Institutions

- California State Government (which has largely pre-empted city regulations on TNCs).
- LADOT – Los Angeles Department of Transportation (responsible for managing transportation infrastructure in the city). Due to structural silos, instruments used for some New Mobility Services are not applied to all mobility services.
- LA Metro – Los Angeles County Metropolitan Transport Authority (responsible for public transit in the county of Los Angeles, limited coordination with LADOT).



Policy and steering

- Taxi regulations and dockless mobility regulations.
- Data standards and data sharing requirements through MDS.
- Incentive structure (in development) for reaching or exceeding performance metrics (financial, access to curb, right of way priority, mobility hubs with vehicle charging, access to LAX airport).
- LADOT strategic plan.



Stakeholders and interests

- LADOT
- LA Metro
- California State Government
- Taxi companies
- New mobility providers (TNCs, bikesharing, e-scooter sharing, micro-transit), data companies (Lacuna Technologies (creator of MDS), Populus, Remix, and others (translating raw MDS data into usable dashboards))



Market structure and characteristics

- LADOT has a long-term vision on MaaS and shared mobility and has put in place or is developing structures (MDS, incentive structures, universal booking system) that will help them steer towards city goals.
- LADOT is highly pragmatic in its approach, putting out regulations in clear steps, testing with different modes, modifying approaches, building political support and then expanding to other modes.
- LADOT and LA Metro do not fully cooperate on their MaaS strategies.
- The app offered by LA Metro does not include integrated booking and payment for different mobility services. LA Metro also offers a separate bikesharing app.
- The government wants to create an ecosystem in which private players have the flexibility to propose and implement innovative services.
- While there is widespread use of TNCs, e-scooters and, to a lesser extent, bikes, there is no widely adopted MaaS app yet (outside of privately-run, walled garden MaaS apps) that integrates different public transport and New Mobility service providers.

Key MaaS ingredients and government actions in Los Angeles

Figure 8 highlights the key MaaS ingredients and government actions in Los Angeles. This figure shows the most important actions and outcomes plotted over time (from left to right).

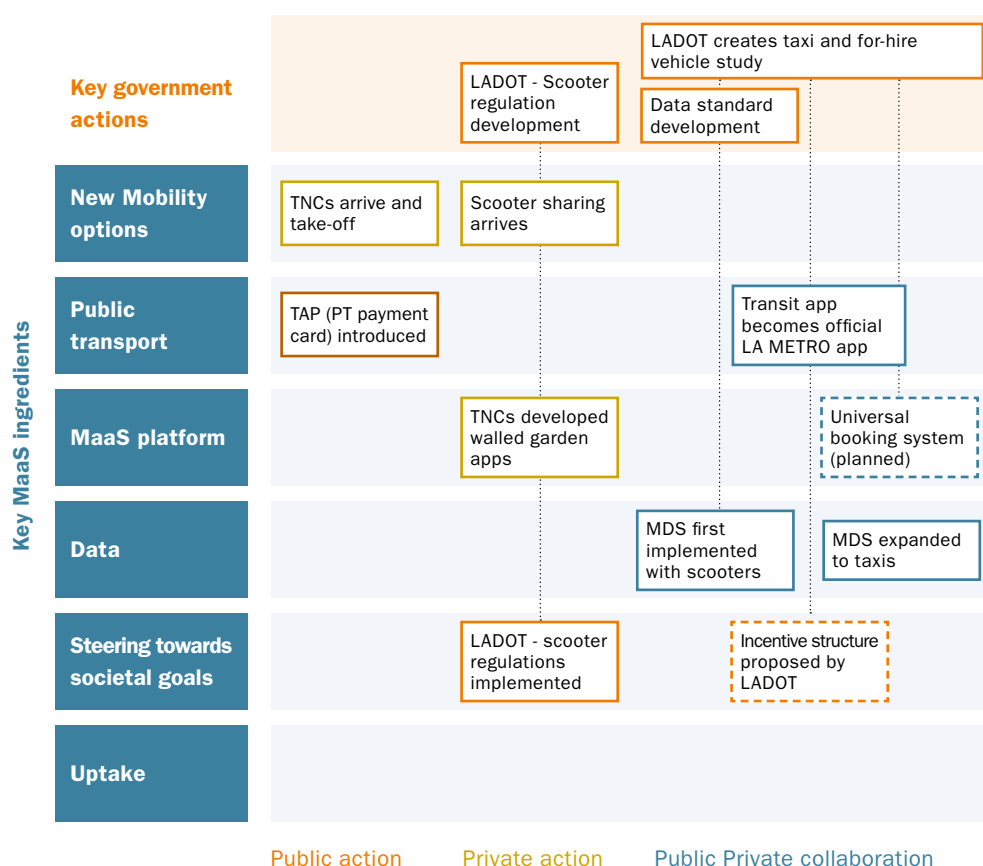


Figure 8 Overview of Los Angeles case: key MaaS ingredients and key government actions.

Let us introduce mobility in the LA region

LA is a large metropolitan area with a relatively low density (compared to typical European cities) in the suburbs outside of the Central Business District. Although there have been significant advances and a growth of public transport recently, the transport system is primarily car-dominated with approximately 90% of trips by privately-owned vehicles. A key difference with the transportation system in European countries is the large supply of New Mobility Services such as transportation network companies, bikesharing and e-scooter companies. LA has a small but growing public transport system (pre-COVID) with a relatively small market share (compared to European cities). Also, the bike and walking infrastructure has not been historically well-developed or inviting, although there is a current push to change this throughout the region.

Private introduction of New Mobility Services

Taxis and the threat they felt from the introduction of TNCs played an important role in the LA story. Similar to the reactions seen worldwide, the arrival of TNCs in 2012 caused turmoil for the taxi industry, an industry that had low margins and difficulty innovating in part due to heavy existing regulations. Taxi use peaked soon after the arrival of Uber and had declined by 51% by 2017. Through extensive lobbying, TNCs were permitted in California at the state level, so the city had no authority to set minimum standards as with regular taxis. LADOT (LA Department of Transportation) wanted to level the playing field between taxis and TNCs and was also worried about the effect of TNCs on equity, congestion and sustainability goals.

Coinciding with the growth of TNC use, private transportation service companies introduced shared e-scooters in 2018 and these quickly grew in popularity. By the end of 2018, Uber was already offering a 'walled garden' MaaS option through which customers could reserve ridesharing, bikes and/or e-scooters with a single app. The large growth of e-scooters, along with a smaller but substantial growth in bike and carsharing and the continued growth of TNCs, caused LADOT to think comprehensively about its role in how best to manage the transportation infrastructure and ecosystem.

In order to investigate their concerns regarding both TNCs and other forms of shared mobility, LADOT commissioned a Taxi and For-Hire-Vehicles Study in 2018. The study report, published in August of 2019, laid the groundwork on how shared mobility could eventually work in LA and included a few key components:

- A shift away from a franchise system for taxis to an open market with entry requirements and TNC-like upfront pricing and payment options (in order to let them be nimbler and more competitive).
- The definition of regulatory categories for mobility services (so that they could more easily be regulated).
- A framework for an incentive structure that could help get mobility companies to support societal goals.
- A recommendation to create a 'Universal Booking System' (basically a MaaS platform).
- A recommendation to develop data standards (which became the Mobility Data Specifications or MDS).

MDS

A key aspect of LADOT's strategy for shared mobility and MaaS was their realisation that they needed both data standards and data sharing requirements. LADOT saw this as a critical element in allowing them to understand transportation use, regulate companies and be able to incentivise and shape transportation company behaviour towards city goals. This led to LADOT's 2018 commissioning of a private company to develop MDS, the Mobility Data Specification. MDS is an open-source, versioned data sharing standard that allows two-way data exchanges between transportation service providers and LADOT. While led by LADOT, the development was an open process in which all were encouraged to join the standardisation talks.

While the initial idea was to develop the data standards for TNC use, the political power of TNC companies made this difficult. LADOT envisioned a long game with data requirements and decided to implement them first with e-scooters, a fast-growing industry that did not have sufficient political weight – or state level authorisation – to escape this regulation. By late

2018, LADOT had released the first version of MDS and the first companies started using it in a limited dockless vehicle pilot.

“We, in cities, have tried to regulate the device, the thing that showed up, instead of thinking about how we can put ourselves in the correct seat around the business model... In Los Angeles, we’ve been thinking about how we can behave more like a product company. We will never be a product company, but we need to think like a product company... The way Google and Apple invite innovation on their platforms is that they have terms and services that the companies agree to and then they can sell their products in the app store. As soon as they violate those terms and conditions, they are out of the app store.”³

Seleta Reynolds – LADOT General Manager

LADOT incentive structure - steering towards societal goals

The arrival of New Mobility Services (TNCs, vanpooling, shared cars, bikes and e-scooters) made LADOT realise that the boundaries between the traditional verticals of public transportation (transit) and private cars have become more and more blurred. This led to a shift in their thinking from managing the verticals to thinking more broadly about transport regulation and the integration of a range of mobility options. Social equity, environmental concerns and the creation of a level playing field – particularly for the existing taxi services – are the main drivers of LADOT’s actions around new mobility and MaaS-related programmes.

LADOT is now working towards setting up incentive structures to help steer towards societal goals. Their approach is incremental and the first step has been with e-scooters but has not yet been widely implemented and is still under development. MDS is seen as a critical building block for the incentive structure as the data offers both a way to track what is actually happening on the streets and provides a mechanism to communicate with mobility companies in real time. The incentive structure aims to change the private offerings to align better with societal goals. As a base, transportation service providers are required to meet minimum performance indicators in order to have access to markets. As companies reach or exceed performance metrics, however, they can receive benefits such as financial incentives, access to curbs, priority in the right of way, access to mobility hubs with vehicle charging and/or access to LAX airport. Many of the performance metrics being considered focus on mechanisms to assist low-income neighbourhoods with poor mobility options, reducing congestion or increasing sustainability.

Public MaaS development, stalled due to COVID

Before COVID, LADOT had planned to develop a universal booking system themselves or to incentivise private sector markets to do so. This is an important next step for the MaaS ecosystem in LA, where the agency was taking public action to develop a MaaS platform. The COVID crisis has had immediate effects on LADOT’s budgets and has resulted in the postponing of the development of a universal booking system.

Public transport

Public transport is organised by the Los Angeles County Metropolitan Transport Authority (LA Metro), responsible for mobility in the county of Los Angeles. While LA Metro does not have a full MaaS platform in place, it has deployed many ingredients of that platform. In 2008, they introduced the Transit Access Pass (TAP), which is a public transport payment card that can be used in LA County and involves 26 agencies. LA Metro runs the Transit Access Pass (i.e. they are responsible for the card technology) and fare collection is managed by the private company Cubic Transportation Systems. The pass can be used for the Metro bikesharing (to unlock the bikesharing; further payment is by credit card). LA Metro has the ambition of soon integrating multiple (New) Mobility Services. This initiative is called TAPforce. LA Metro is currently working on getting New Mobility service providers on board. In 2020, the public transportation app became LA Metro’s official app. While both agencies are well aware of each other’s programmes, LA Metro’s efforts around MaaS do not seem to be specifically coordinated with LADOT’s efforts.

Room for private development (yet no longer unlimited)

Generally, public agencies in the US have given significant room to private companies to offer transportation services. This is in part due to a culture and legal structure that limits regulatory control and in part due to public agencies choosing to leverage the innovation and risk-taking often found in the private sector. The private sector also often has a role in various parts of the MaaS ecosystem. For instance, in addition to private sector mobility providers (of various modes), private sector companies have also been involved in the development of MDS, in helping cities manage MDS data and dashboards, in offering business intelligence services to cities and in providing fare collection across public transport service providers. When societal goals are at stake – and, compared to Europe, there is a larger emphasis on social equity – public authorities do step in and regulate the private sector. As seen in the LADOT case, public agencies rarely aim to completely take over areas of the transportation sectors but instead aim to steer towards societal goals by setting framework regulations that still allow private companies to offer their services.

³ <https://medium.com/bestmile/should-cities-put-mobility-services-on-private-maas-platforms-928f1cb9a68>

MaaS uptake

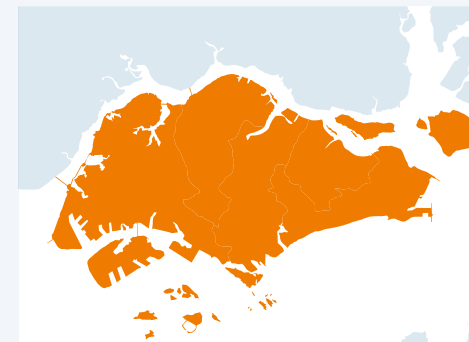
LA has a large uptake of New Mobility Services and public authorities have (sometimes reluctantly) given substantial room for the development and implementation of these services. Although they are not open platforms, TNC apps often do offer finding, booking and payment for multiple New Mobility Services. These walled garden apps have had substantial uptake but the use of modes outside of ride-hailing is still relatively small. The risk of the growth of these walled gardens is that consortia of companies could extend their market power and end up with a monopoly. In addition, a point of attention is that public transport is often not included in these apps, although some TNCs are experimenting with this possibility. It is still unclear if the growth of TNCs and their expansion into other modes will eventually be at the cost of the already vulnerable public transport system.

MaaS outlook

LADOT aims to steer towards societal goals. The MDS (which arranges data sharing and standardisation) is seen as giving an important foundation for this. The next steps are on the table but have been stalled due to budget issues connected to the COVID pandemic.



3.6 SINGAPORE



Context

- 5.7 million inhabitants; 7917 inhabitants/km²
- Modes: strong public transit network used by many, growth in active mobility and micro-mobility, some sharing mobility, car use and ownership are limited and expensive. MaaS app available (limited options and not fully integrated with all service providers).
- Starting point: MaaS/New Mobility seen as a chance for better integration of all transport services, especially the first/last mile of public transport trips.



Highlights

- No specific public MaaS strategy. Strategy mostly focused on enhancing existing public transportation and regulating private vehicle use.
- Regulation of mobility takes place per mode, not across modes. Focus is on organising good access for mass movement, mainly via a public transport backbone. New Mobility modes and MaaS are seen as options to strengthen this.
- Regulation takes place to safeguard commuters' interests.
- Public transport is dense, affordable and has a high mode share. The government sees it as the backbone for the mobility system and MaaS could be an opportunity for first and last mile connections inside the public transport system when it comes to further stimulating the efficiency of the public transport system.



Timeline

- 2014: Smart Nation initiative is launched
- 2016: LTA introduces bus contracting model which allows for ticketing data to be collected and for supply to be adjusted according to capacity and loading
- 2017-2018: Nanyang University, JTC Corporation and SMRT create MaaS app in a living lab on the university's campus
- 2018: MobilityX is founded as a spin-off of the living lab with MaaS app Zipster
- 2018: Singapore sets stricter regulations on bikesharing after problems such as indiscriminate parking and irresponsible user behaviour
- 2018: Active Mobility Act comes into force, regulating the use of bikes and other forms of micro-mobility
- 2019: Land Transport Master Plan 2040 is released by LTA
- 2019: MobilityX launches Zipster app



Goals, motivations and desired outcomes

- Become a 'smart nation' with ambitious plans for becoming one of the cities with the smartest mobility.
- Car-lite society with a strong public transport network as a backbone and smart use of technologies.
- Promoting active transportation (creating sheltered walkways and doubling the amount of bicycle lanes (700 km extra) by 2030) for first and last mile travel.

**Strategy and approach**

The government enables the private development of smart mobility technologies in Singapore by giving private parties access to their data mall, which allows private players to innovate within their boundaries. The government views the development of MaaS in Singapore as something that should achieve societal goals that fit the long-term vision of Singapore. Public transport is seen as the backbone of the mobility system (64% of households already live within a 10-minute walk of a public transport station; in 2030, the goal for that number is 80%). MaaS and New Mobility could provide multimodal, on-demand mobility services that fill the gaps for first and last mile options and offer a seamless transport experience. MaaS can reduce the usage of privately-owned transportation through an integrated mobility solution that meets the changing needs and demands of commuters, thereby fulfilling Singapore's vision of becoming a car-lite society and improving commuters' travelling experiences. The government steers on the basis of societal goals and is user-centred, not focused on technology itself.

**Institutions**

- Land Transport Authority (LTA).
- Government Technology Agency (GovTech) - Smart Nation initiative with high-level goals that overarch sectors.
- Public transport providers are privately owned.
- Regulation takes place to safeguard commuters' interests (e.g. public transport affordability, service standards, indiscriminate parking, irresponsible user behaviour, etc.).

**Policy and steering**

- LTA, Land Transport Master Plan 2040 (LTMP 2040): goal to build a transport network that is convenient, well-connected and fast.
- LTA, Active Mobility Act: regulation around active modes and the redesign of public space for pedestrians and active modes. Large investments in pedestrian and bicycle infrastructure connected to public transport nodes and going into the city.
- Strong regulations within verticals such as shared bikes and light electric vehicles (called Personal Mobility Devices or PMDs in Singapore) due to clutter and safety issues.
- Steering towards public transport use (affordable prices, high convenience).
- Limits on cars (high costs as a result of caps on the number of cars).
- Not yet actively regulating MaaS platforms.
- Smart Nation Vision Singapore.
- Sustainable Singapore Blueprint.
- Different pilots on smart mobility technology, such as automated shuttles.

**Stakeholders and interests**

- LTA, Public Transport Council.
- Public transport operators, taxi operators.
- New Mobility service providers (car, bike, scooter sharing, TNCs).
- MaaS app providers, e.g. MobilityX (offering the Zipster app).

**Market structure and characteristics**

- LTA is partnering with private parties promoting account-based ticketing.
- MobilityX received funding from JTC (government agency overseeing industrial development) and industry investors.
- Other MaaS app providers (e.g. Whim) have had difficulty creating a viable business model in Singapore. From the government side, there is no specific push for MaaS. However, MaaS is allowed into the market as long as it serves as a plus to the current system and adds to societal goals. This mostly has to do with filling in the gap for first and last mile options. The private sector is free to innovate while government is responsible for organising a level playing field.

Key MaaS ingredients and government actions in Singapore

Figure 9 highlights the key MaaS ingredients and government actions in Singapore. This figure shows the most important actions and outcomes plotted over time (from left to right).

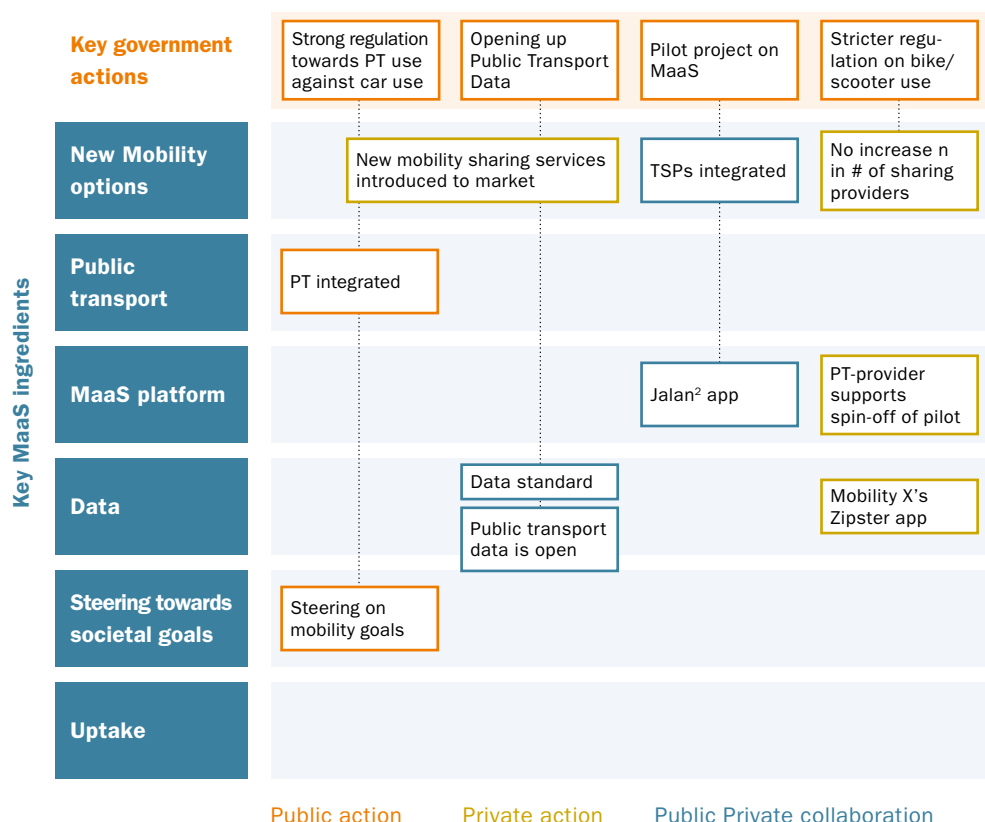


Figure 9 Overview of Singapore case: key MaaS ingredients and key government actions.

Let us introduce mobility in Singapore

Singapore is a densely populated city-state that faces the challenge of efficiently managing the scarce space available. In comparison to other countries or cities, Singapore has a unique position in that almost all land is publicly owned, which allows the government to steer spatial planning. To reduce the space needed for transportation, there is a strong focus on public transport and on reducing private car ownership. The public transport infrastructure is world-class and very affordable for users. Public transport thus also sees high ridership rates: the mode share of public and shared transport in peak hours is 74% and the plan is to further increase this share up to 90% in 2040. There is high user satisfaction with the public transport system and low congestion. In recent years, infrastructure for walking and biking have also received more attention and the government is promoting active transportation as a mode of transit. These active modes will also be stimulated in order to fill in the gaps between home or work and public transport stations and serve as first and last mile transport options. There are sheltered walkways connected to public transit modes and large investment plans for the

extension of the bike infrastructure by more than 200% in the coming years. Congestion pricing and strong regulation of car ownership are some of the measures to discourage private car ownership and use.

Singapore as a smart nation (institutional context)

Singapore has ambitious plans on becoming a 'smart nation', and making the transportation system 'smart' is part of this plan. Steering towards this ideal is strong and investments into projects leading to this 'smartness' are high. Singapore has benefited from its high-quality public transport, roads and unified management under the Land Transport Authority (LTA).

LTA has set up a Land Transport Master Plan 2040 (LTMP 2040) with goals on making the transport network convenient, well-connected, fast and inclusive and enabling healthy lives and safe journeys. Singapore is striving towards a car-lite society with a strong public transport network as the backbone while making use of smart technologies. Although public transport is operated by private companies, all public transport assets are publicly owned. Government agencies enable the private development of smart mobility technologies in Singapore through the sharing of travel information to be utilised by innovative smart mobility technologies which fit the societal goals that Singapore strives towards. It is a challenge to balance the public and private interests in a positive way. Public consultations with all user groups take place on a large scale as part of Land Transport Masterplan consultations, including disadvantaged groups such as people with a disability. Furthermore, user engagement is applied case by case when necessary by both the LTA and an independent body (PTC).

Programmes for reaching the smart mobility goals, as well as LTA departments, are subdivided into different areas (e.g. ITS, EVs, automation). Regulation around New Mobility Services has been reactive whenever necessary (e.g. when shared bikes and e-scooters created disamenity among the public). Of course, the question is what room should actually be made for experimentation or if regulations should be made very strict to limit innovative capacity.

The Smart Mobility vision sets goals that are overarching and does not set specific goals on MaaS. As a result, there is also no overarching MaaS programme. The government is not targeting the development/stimulation of MaaS itself as the added value is not yet clear and specific, for instance how it incentivises the use of first and last mile options that feed into the currently well-functioning public transport system (in which a lot of public money is invested).

It is also a challenge to develop a viable business case for MaaS in such a dense urban environment with a high public transport mode share. The government, however, does stimulate innovation by private players while steering towards innovations aligning with their societal goals. From this perspective, an interesting step is that all public transportation data is made openly accessible, which is supposed to enable New Mobility solutions for convenient first and last mile travel. Private parties also share data with the government on their operations. This data is not made public and is only used by the government as a regulator of service standards and agreements.

The introduction of MaaS in Singapore

New Mobility Services such as sharing services and TNCs are seen as possible solutions for improving first and last mile options for public transport trips. The introduction of these new services, as well as trials around data-driven public transport routing, initiated the idea of starting a MaaS pilot. In 2017, a MaaS testbed was started as a joint endeavour between Nanyang Technological University (NTU) Singapore, JTC Corporation (a government agency for sustainable industrial development) and SMRT Corporation (a public transport provider) on the NTU's campus. The goal was to deploy and demonstrate an integrated mobility solution which integrates existing transport services (public transport, campus shuttle buses) together with New Mobility Services such as personal mobility device (PMD) sharing and autonomous vehicles. For this, an app called 'Jalan2' was set up that allowed for planning, booking and payment.

Market development

After the pilot project ended, the partners decided that continuing the development of the MaaS app would best be done in a separate private company. MobilityX was thus founded in 2018 as a spin-off. In September 2019, MobilityX then launched the Zipster app in Singapore, Asia's first all-in-one Mobility as a Service (MaaS) application and payment wallet offering multimodal trip planning, booking and payment. Other players in the mobility service market include Moovit and Citymapper, which offer access to multiple modes through their own app (but organised in a 'walled garden' and only suited to journey planning). The offer of shared mobility services has decreased since Singapore was flooded with sharing initiatives that disrupted the streets and regulation was set in place as a response to indiscriminate parking/disamenity as well as safety issues. Many providers have now left the market and only some bikesharing offers remain, of which uptake is limited. Mobility sharing companies also still have to be convinced that the MaaS platform offers additional value to them.

The Zipster platform in Singapore has not faced much competition from other MaaS platforms. The market is relatively small (since it is only the city-state of Singapore), which does not leave much room for another MaaS platform. However, the modes represented in each vertical do compete with each other.

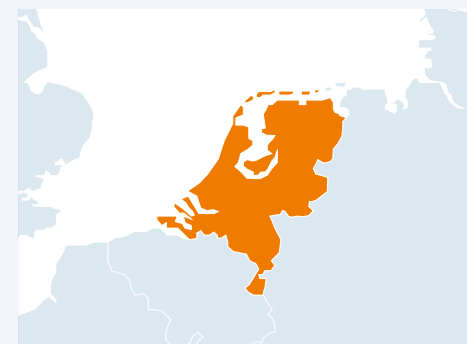
MaaS uptake

The context in Singapore is clear: fierce regulation of car ownership and use, a well-developed public transport system, a compact spatial structure and a government that swiftly takes actions whenever deemed necessary. Opening up real-time public transport data makes it possible for private actors to integrate public transit in their service offerings and to innovate based on the data provided. However, because of the strong focus of the government on public transport, it seems that there is less of an urgency to initiate the integration of different services (outside of public transit) if not destined for first and last mile travel. The clear potential of MaaS in Singapore lies in improving the first and last mile options for travellers, but with the dominance of public transit and little focus on the integration of non-public transport modes, the question is whether this will really take off.

The commercial business case for first movers in the MaaS ecosystem in Singapore remains a great challenge and the current situation with the COVID pandemic has brought even more pressure to the situation as travel by public transit and New Mobility modes has dropped significantly.



3.7 THE NETHERLANDS



Context

- 17.2 million inhabitants; 508 inhabitants/km²
- Modes: public transport and sharing modes. National MaaS (finding, booking, payment) are in development with small uptake.
- Starting point: optimising the mobility system (infrastructure and vehicles) to reach policy goals.



Highlights

- The Netherlands has a large nationwide programme for MaaS.
- The programme consists of seven scalable national MaaS pilots that start from the different policy goals of the regions involved.
- A great deal of effort is paid by the Ministry to building public-private partnerships, a level playing field, data sharing and data standards, as well as the development of a knowledge and learning environment to exchange public-private data for learning. Aim is to steer on policy goals through MaaS (level 4) based on data.



Timeline

- 2015 MaaSifst: public-private taskforce to coordinate MaaS
- 2015-2018: Shared bikes introduced in all major cities, quickly followed by municipal regulations
- 2016: Ministry started with MaaS as part of the 'Beter Benutten' programme focused on better utilisation of infrastructure
- 2018: Tender for seven MaaS pilots starts as part of a national coordinated MaaS programme
- 2019: Framework Agreement granted
- 2019: Four largest public transport companies start to develop their own MaaS platform and app (RiVier initiative)
- 2020: First MaaS apps from MaaS pilot programme have started in Utrecht, Limburg and Eindhoven



Goals, motivations and desired outcomes

- Maximise learning on the impact of MaaS on policy goals such as accessibility (including rural areas), congestion, sustainability, liveability and social inclusion, etc.
- Each of the seven national pilot has a specific policy goal (i.e. stimulate cross-border mobility, lease car alternatives for employees, integration of public transport and transport for elderly and disabled people).
- A learning environment (dataspace) has been set up to measure impacts, better understand travellers' behaviours and learn how to steer policy goals.



Strategy and approach

- The government takes an active role in organising knowledge development on impact and steering possibilities for MaaS data, interoperability, a level playing field and data standards.
- Developing data exchange standards, e.g. data strings for data exchanges with a learning environment and a TO-MP API in a public-private collaboration.
- Public parties are not offering services themselves but facilitate collaboration and the growth of private players. Public parties finance the development of MaaS apps offered by consortia of private players in each pilot.



Institutions

- Ministry of Infrastructure and Water Management
- Tender Pilot and Framework Agreement
- Mandatory TO-MP API
- Provinces and regions
- Concession providers for public transport
- Cities and the Ministry
- Implement policy instruments to manage the introduction and use of shared cars, bikes and e-mopeds



Policy and steering

- Financial investment of a maximum of €20 million by the national government, regions and cities in seven national scalable pilots.
- Development of knowledge and learning environment and standardisation of data exchanges.
- Development of City Data Standards - Mobility by the five largest cities (based on MDS).
- Cities all use different packages of policy instruments to manage shared mobility: cap on the number of shared cars/bikes/scooters, cap on the number of suppliers, contribution to societal goals, parking regulations.
- Competition law, regulated by the Netherlands Authority for Consumers and Markets (ACM), ensures fair competition between businesses and protects consumer interests.



Stakeholders and interests

- Ministry of Infrastructure and Water Management
- (Large) municipalities, provinces and regions
- Public transport providers
- Joint venture of four largest public transport companies called RiVier
- New Mobility service providers and private companies
- Interest organisations (consumers, mobility providers)



Market structure and characteristics

- The Ministry aims to create an open public-private ecosystem in which private players offer MaaS services.
- In the publicly-financed pilots, each (consortium of) private player(s) will develop its own MaaS app and use TO-MP to build an open ecosystem.
- There are a number of private mobility companies (with and without public contracts) e.g. (water)taxi, bike, moped & carsharing and transport of the elderly, chronically ill and people with a disability (WMO/Valys).
- The 23 parties in the Framework Agreement of the Ministry are diverse.
- Some public transport companies own their own shared car and bike options.
- There are four public transport companies with directly awarded contracts from the government to develop their own MaaS platform and app via a joint venture.
- The national government facilitates cooperation and forces open data. The private players from the Framework Agreement and the pilots take up the role of MaaS operators. The government does not take an active steering role in shaping the market.
- The government's vision is to steer towards policy and societal goals.
- New Mobility service providers offer shared services in cities; uptake is still limited but growing.

Key MaaS ingredients and government actions in the Netherlands

Figure 10 highlights the key MaaS ingredients and government actions. This figure shows the most important actions and outcomes plotted over time (from left to right).

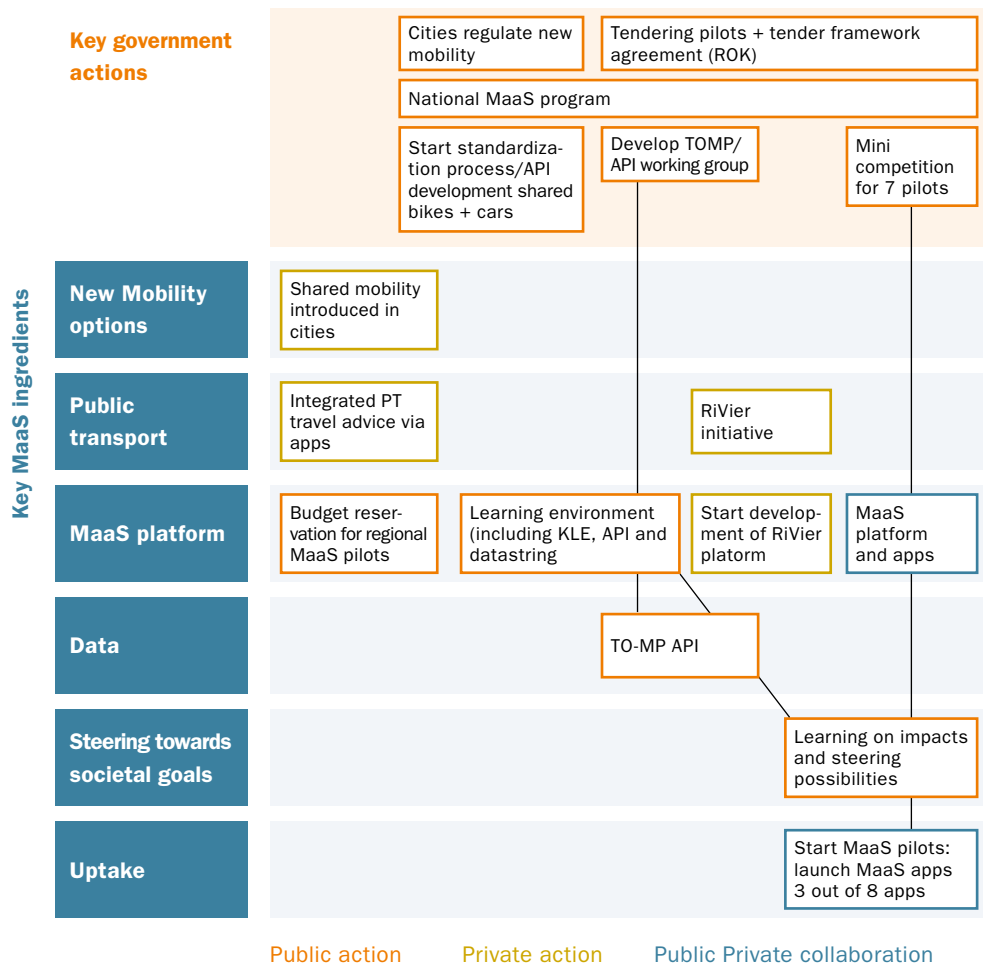


Figure 10 Overview of The Netherlands case: key MaaS ingredients and key government actions

Let us introduce mobility in the Netherlands

The Netherlands is a densely populated country with the most density focused in the Randstad region (western part of the country). The transport infrastructure in the Netherlands is well-developed. The Netherlands is one of the frontrunners in cycling infrastructure and use, has a high-quality public transportation system and the road infrastructure (including the uptake of electric mobility) is considered highly suitable for the introduction of automated vehicles (KPMG, 2020).

MaaSifest: “We are a long way with MaaS”

The Netherlands has elements in its transport system that could be considered building blocks for MaaS, although they were developed before it was framed in this way. Examples include a nation-wide public transport payment system that integrates payment of all public transport providers (OV-chipkaart), nationwide parking services like the Yellowbrick and Parkmobile app for on-street parking, nationwide taxi coverage by Transvision, the OV-fiets (station-based bikesharing) and Greenwheels (station-based carsharing) (MaaSifest, 2017:16). Carsharing was introduced in the Netherlands in 1993 with slow but steady growth. Free-floating and peer-to-peer carsharing has brought quicker development to the market since 2012 but uptake is focused on the larger cities (CROW, 2019).

The rise of New Mobility Services

In 2015, Connekt (ITS Netherlands) took the initiative for a MaaS taskforce; a public-private initiative with the aim of speeding up MaaS adoption in the Netherlands (Connekt, 2015). In 2017, this resulted in the presentation of a Mobility as a Service action plan for the Netherlands supported by 40 stakeholders in this field (Connekt, 2017). In this period, more and more New Mobility service providers investigated opportunities (i.e. Whim) or started New Mobility Services in the Netherlands. Several public transport providers expanded their services to include multiple modes in their apps (9292 – nationwide public transport information, NS national railways app, HTM regional public transport provider).

The most visible development in New Mobility options was, as with many other countries, the sudden and tumultuous introduction of shared bikes by (primarily Asian) companies. In Dutch, they were called ‘thrown bikes’ as they were scattered all over the largest Dutch cities, causing a nuisance and starting debates about parking and the use of public space. The cities quickly responded with different regulations.

With similar timing as in other European countries, Uber (UberBlack) also arrived in 2012 and introduced UberPop in 2014. This introduction was met with fierce resistance from taxi companies and public authorities. Following lawsuits, UberPop was banned in 2015.⁴ The Netherlands is, together with the United Kingdom, among the few countries that does not allow light electric vehicles (e.g. electric stand-up scooters, hoverboards, etc.) on public roads (TNO, 2020).

The national government is investigating the introduction of micro-mobility (Rijksoverheid, 2020). The most recent development is that regional concession providers have decided to comply with eight requirements to make public transport concessions MaaS-ready before 2022. Amongst other things, this allows public transport operators to offer their tickets for the same price via other service providers (CROW-KpVV, 2019, OV-Magazine, 2020 and OVPro, 2020).

⁴ Pelser, Koenen and Boon (2019) Institutional entrepreneurship in the platform economy: How Uber tried (and failed) to change the Dutch taxi law. Environmental Innovation and Societal Transitions, Volume 33, November 2019, Pages 1-12, <https://www.sciencedirect.com/science/article/pii/S2210422418301631>

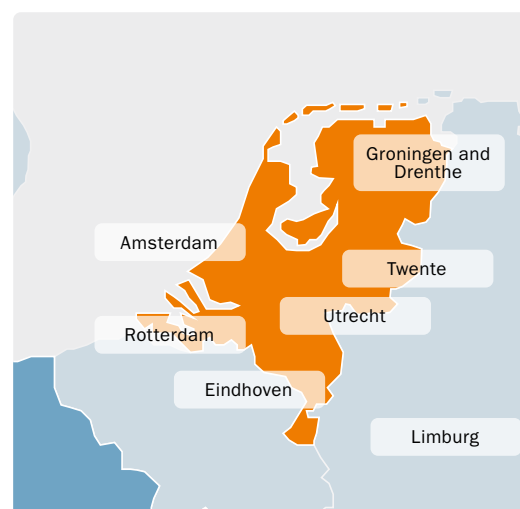


Figure 11 Seven MaaS pilots

Region	Consortium of private companies
Groningen and Drenthe	To be determined
Amsterdam	OverMorgen, Radiuz, Amber, Transdev (Amaze)
Twente	Tranzer, Qarin, Ideate, MaasPortaal (GOANI)
Utrecht	Innovactory (GAYIO)
Rotterdam	PON, REISinformatiegroep, Deloitte, CGI (Moves)
Eindhoven	ICT-Group (Turnn)
Limburg	Arriva, Tranzer, InTraffic (ViaGo)

Core of the national MaaS programme: seven national scalable MaaS pilots

The starting point is that MaaS is a means to optimise the entire mobility system (with all modalities integrated) in order to reach policy goals. In 2017, the former Ministry of Infrastructure and the Environment initiated seven national scalable MaaS pilots starting from different regions. Through these pilots, the parties involved “want to gain more insight into the effects of MaaS. In order to maximise the learning effects, the pilots have various objectives and learning questions. The pilots will start at the regional level but must be able to be scaled up quickly at national level” (Rijksoverheid, 2018:4). The idea is that a large scale is feasible as a business or value case. The pilots have been started from seven different regions of the country (see Figure 11). Each pilot has its own set of objectives (i.e. accessibility of the Rotterdam–The Hague airport, commuting of employees in the city of Eindhoven, multimodal cross-border mobility in Limburg). Each pilot has a targeted geography ranging from (parts of) cities (i.e. a neighbourhood in Utrecht and the central business district in Amsterdam) to an entire region. The three main target groups in the pilots are citizens in a specific neighbourhood, commuters and the elderly, the chronically ill & people with a disability. The diversity of the pilots aims to measure and maximise learnings on the meaning of MaaS, the impacts of MaaS on mobility behaviour and how to steer behaviour such that it contributes to societal goals, specifically in optimising the mobility system. In Q3 2020 and Q1/2 2021, the first three MaaS pilots began.⁵

⁵ <https://www.verkeersnet.nl/smart-mobility/34882/eerste-twee-nationale-maas-pilots-van-start/>

Since mid-2016, the Ministry of Infrastructure and Water Management (Ministry of IenW) has been discussing MaaS with regional authorities and private companies. In 2017, the Ministry of IenW published a whitepaper discussing definitions and models of MaaS (MuConsult, 2017). The same year, they began the collaboration with regional authorities to set up four to seven MaaS pilots. At the end of 2017, the Ministry of IenW presented the seven pilots and started the market consultation as preparation for the tender process of the Framework Agreement for seven national scalable MaaS pilots resulting in eight apps.⁶ In 2018, agreements were made on the budgets. The MaaS pilots are co-financed by the regional authorities and the Ministry of IenW up to a total of €20 million (for seven pilots). The financing is meant to cover the start-up costs of a MaaS service. The private companies executing the pilots are largely funded by public authorities. The idea is that after the pilots, they will have established a viable business case. The Ministry of IenW started the pre-competitive dialogue. This tender process resulted in contracting consortia of very diverse private parties via a Framework Agreement which is valid for all pilots (in Dutch: RaamOvereenkomst). 41 consortias applied for the tender procedure for the Framework Agreement. 24 were admitted. Under the Framework Agreement, the regions started mini-competitions for the regional pilots. Next, each region granted a project to one consortium or a combination of consortia. The selected consortia/MaaS providers have very different backgrounds ranging from IT companies to public transport operators to mobility card providers.

The national MaaS programme: an overview

The MaaS programme of the Ministry of IenW focuses on “facilitating cooperation and data exchanges between relevant parties and starting up seven regional, nationally-scalable MaaS pilots to gain experience with MaaS” (Rijksoverheid, 2018:1). It all started with an extensive market consultation on the ambition to launch seven national apps with a two-year subsidy. Based on this consultation, a number of principles were set for the European tender of these pilots. These principles are the adoption/application of identical MaaS definitions and functionalities, a data sharing obligation (quid-pro-quo), the application of open standards as defined by the Ministry, an open ecosystem, learning together with other parties via a knowledge and learning environment, non-discrimination and a level playing field and privacy and security obligations. Alongside the efforts on the tender and ecosystem for the pilots, IenW also started a data standardisation process resulting in the definition of standard APIs. The formulation of the data principles (rules of the game on, amongst other things, a level playing field and data sharing, which is part of the Framework Agreement with private parties) and the KLE API (API connecting a MaaS provider to the learning environment) and the related data string (specification of data components of trips made by travellers, which MaaS providers have to share with the learning environment) were already mentioned in the Framework Agreement.

The main idea behind the development of standards is that this makes it easier to assess the impact of MaaS and, in particular, allows smaller and newer players to enter the market (level playing field) and to be found in different MaaS apps via a harmonised API. Upon the request of private companies, IenW supported a standardisation process for shared bikes after an interoperability requirement was introduced as a result of the thrown bikes experience in large cities. This led to the foundation of the TOMP API (an API connecting a transport operator to a MaaS provider via an open Github involving many international (shared) transport operators).

⁶ One pilot develops three MaaS apps and one MaaS app will be used in two regions

Currently, IenW, the TO-MP working group and the five largest cities are developing the City Data Standards for Mobility (CDS-M) based on MDS. Parallel to these developments, the Ministry of IenW is working on an overarching knowledge and learning environment. They started with the development of the learning environment, which aims to monitor all pilots in a uniform way such that all stakeholders involved (governments, transport operators, MaaS providers and researchers) can learn about MaaS via anonymised data. IenW has standardised data sharing with the learning environment and institutionalised this as part of the Framework Agreement with the private parties. As soon as the pilots are fully up and running, data is expected to come in. The Ministry of IenW hired TNO (independent research institution) to develop the learning environment, which is currently a reporting tool supporting the gathering, processing and analysis of pilot data. The Ministry of IenW also organises periodic knowledge exchange meetings for all of the research institutions that work on MaaS in the Netherlands.

Public transportation companies as MaaS providers

In January 2019, the four public transport companies with direct awarded contracts from the government announced their MaaS collaboration, the 'RiVier project'. The four parties are the NS (the concessionaire of the main railway network and the largest train operator), GVB, HTM and RET (the public transport companies in the larger Amsterdam region, the Hague region and the Rotterdam region, most known for their metro/tram and bus services in these regions). These parties offer transitional public transport services and shared mobility services and intend to offer MaaS services. These parties want to realise a MaaS platform to offer technical connection services to MaaS providers and mobility providers and set up a joint venture to organise this (ACM, 2020:3). Following an investigation by the competition authority ACM, they have made several arrangements and built in safeguards to satisfy potential concerns regarding competitiveness. Amongst other things, they pledge that their public transport services "will be available to all MaaS providers regardless of whether they are included in their platform or not; (...) [they will] ensure access to their platform for all MaaS and mobility providers under fair, reasonable and non-discriminatory conditions and make sure that they will not have access to competition-sensitive information" (ACM, 2020:5). The Dutch Authority for Consumer and Markets therefore came to the conclusion that no license is needed for this collaboration. The initiators are moving forward with this development.

A culture of stakeholder cooperation

A key characteristic of the Netherlands is a long and broad history of cooperation. The transport sector is traditionally very siloed. The number of stakeholders involved in MaaS is large; there are many private companies, public authorities and interest organisations. The MaaS pilots demonstrate the cooperation between the national government, the regions and the cities. All stakeholder collaborations which are relevant to MaaS have varying starting points and are of different natures. An example of public-private cooperation in one of the silos is the National Public Transport Council (NOVB), a collaboration between public authorities and transport operators. Another example of public-public cooperation is institutionalised in the so-called Joint Forces (Krachtenbundeling), a broad collaboration between the national government, the provinces, the five largest cities and regional cooperation and transport authorities. Another recent example of stakeholder cooperation (private-interest organisations) is the Mobility Alliance (Mobiliteitsalliantie, 2020) consisting of 25 public transport providers and transport and consumer interest organisations. Despite the fact that the largest consumer organisation, ANWB, is involved in the latter initiative, consumer organisations are not the most prominent stakeholder in the field

of MaaS yet. The Ministry is developing an open ecosystem with a level playing field consisting of diverse parties, both large and small and both new and established companies.

MaaS uptake and outlook

Dutch public authorities broadly acknowledge the potential of MaaS for a large variety of policy goals and are actively trying to develop MaaS. Currently, there is no large MaaS app and the uptake of New Mobility Services has been disrupted by COVID. Under the Framework Agreement, several large players are involved in the eight apps that will be developed (e.g. the provider of the transport planning app 9292). Besides the pilots, the public transport providers have initiated the joint development of MaaS services in the RiVier initiative. Despite safeguards by the ACM, this initiative has the risk of becoming a public transport or MaaS monopoly.

All major cities have responded to the introduction of New Mobility Services by bringing their own regulations into place, with the city of the Hague actively steering towards societal goals in their e-moped regulations (Nijhof, 2020).

At the national level, the Ministry of IenW has invested a great deal of effort into setting up pilots and developing multiple MaaS apps that have the potential to reach large numbers of travellers. The set-up of each pilot is very different, so the learning potential is large. It is not yet clear how shared mobility and the seven MaaS pilots can scale up to the national level and what the future business and value case for the (now often subsidised) companies is. The efforts of the Ministry of IenW in the area of data standardisation and sharing and the creation of a learning environment have the potential to be important building blocks for this. According to the first letter to Parliament on MaaS, pilots are for learning and are allowed to fail (Ministerie van Infrastructuur en Waterstaat, 2018:5) and the way forward after the pilot phase needs further detailing.

4 CASE ANALYSIS

4.1 STRATEGY AND APPROACH

The development of MaaS is typically the result of a case-specific evolutionary process in which one main element is often dominant. Finland focused on regulation in order to open up the market, Singapore had no specific MaaS strategy but took a pilot approach and LA focused on one mobility option (taxis and TNCs). Île-de-France and Austria (before the change of government) focused on developing an overall MaaS strategy and the Netherlands is focusing on understanding the impact needed to optimise mobility on policy objectives as well as on achieving an open ecosystem of systems (level playing field). Table 2 describes the strategies and approaches within the case studies in more detail.

Table 2 Strategies and approaches within case studies

Strategy & approach	
Austria	Before the change of government, there was a nationally-coordinated MaaS programme with the active facilitation of MaaS development. Large role for public transport providers, road authorities and research institutes. The MaaS programme was redirected in 2019 after the change of government. The new government puts the public transport providers in the driver seat.
Finland	Legislation provided market access to a previously-closed market in order to offer mobility services. The national government facilitates network building and provides funding for new service providers. The government supported the MaaS provider development nationally and internationally (with financial support and marketing). The government facilitates new players in the developing market.
Île-de-France region (Paris), France	The strategy focuses on setting up collaborations between public and private sector parties through the regional transport authority. The government is heavily involved in pilots and R&D in collaboration with private parties as a MaaS app operator and platform provider. IDFM (regional transport authority), as a public player, takes up main role in development.
Los Angeles, USA	There is room for market parties to develop services and an active role for the government in setting data requirements for shared mobility providers. LADOT (municipal transportation agency) created a vision on steering towards societal goals; this needs further detailing (i.e. incentive structures), which is currently stalled due to COVID. Private players can develop the market but have to follow requirements.

Strategy & approach	
Singapore	Government has no specific MaaS strategy. Regulation – organised per mode – takes place as a reaction to conflicts with the overall Smart Nation strategy. Singapore has a vision of becoming a car-lite society and improving commuters' travelling experiences with public transportation as the backbone. MaaS is framed as an opportunity for first and last mile connections inside the public transport system. Private players develop the MaaS market and the government only steers if necessary.
The Netherlands	Governments (national, regional, local) have set up a joint MaaS programme with a temporary framework (including principles for public-private cooperation) for seven pilots aiming to understand the impact of MaaS on travellers' behaviour. MaaS is seen as a means rather than an end. It could help in optimising mobility on a range of policy issues. To achieve insights, the standardisation of data exchanges between parties and with the government also plays a key role. The national government aims to take away barriers. Possibilities for cooperation with new MaaS initiatives outside of the current framework are also being explored.

One of the main differences between strategies is whether the primary action is along individual modes (e.g. public transport, biking, micro-mobility, taxis, etc.), also called verticals, or along the integration of modes in a MaaS app (see Figure 12).

Primary action along individual modes	Primary action along integration of modes
<ul style="list-style-type: none"> – Austria – Los Angeles – Singapore 	<ul style="list-style-type: none"> – Finland – Île-de-France – The Netherlands

Figure 12 Primary action along individual or along integration of modes

Austria, for now, focuses on public transport, specifically the main railway operator. Singapore and Los Angeles take action in whichever vertical is needed and both approach this on a mode by mode basis. Finland facilitates MaaS development, but execution is taken up by the private sector. Île-de-France takes up the role of MaaS app operator and platform provider and focuses on the integration of modes. The Netherlands focuses on the integration of modes by aiming for an open ecosystem and level playing field for MaaS.

Another key characteristic is whether the strategy is aimed at supporting deployment of mobility options (for eventual MaaS offering) or shaping deployment of existing mobility options (see Figure 13). A strategy aimed at supporting deployment consists of seizing opportunities and taking charge in the development of the MaaS ecosystem – often in bringing (new) mobility options to market. Other places had strong private sector pushes to bring (new) mobility options to market and this incited governments to take action in order to manage and shape these mobility options. Strategies aimed at supporting deployment were found in Austria, Finland, Île-de-France and the Netherlands. In Los Angeles and Singapore, the New Mobility markets arrived and governments tried to understand how to regulate these and create a level playing field.

Supporting deployment of mobility options	Shaping deployment of existing mobility options
<ul style="list-style-type: none"> – Austria – Finland – Île-de-France – The Netherlands 	<ul style="list-style-type: none"> – Los Angeles – Singapore

Figure 13 Strategy aimed at supporting deployment or shaping deployment

Finally, we see public and private actors taking different roles. In Finland, Los Angeles and Singapore, the public authorities set regulation but private actors lead the development of MaaS. In Île-de-France and the Netherlands, the focus is on public-private cooperation but the public actor coordinates things. In Île-de-France, the public authority has set up the MaaS ecosystem and developed a MaaS app; in the Netherlands, the national government initiated and coordinates the public-private cooperation, supported by a Framework Agreement. In Austria (after the change of government), the national public transport operator leads the MaaS strategy, which is steered by the national government.

Private actors lead Public actor sets regulation	Public private cooperation Public actor coordinates	Public transport leads Public actor steers
<ul style="list-style-type: none"> – Finland – Los Angeles – Singapore 	<ul style="list-style-type: none"> – Île-de-France – The Netherlands 	<ul style="list-style-type: none"> – Austria

Figure 14 Actor roles – public and private

4.2 CONTEXT

The context affects the definition and the stage of development of MaaS, which is different in each case. One of the key MaaS ingredients is uptake. As is true regarding the definition of MaaS, there is no consensus on the definition of uptake. It starts with having two other key MaaS ingredients in place: New Mobility options and public transport (the offerings). It has been very difficult to get a good insight into the uptake of the current MaaS apps in use as the number of downloads does not give sufficient information on uptake while collecting ‘real numbers’ has been a great challenge, especially when taking into account the current situation with changes in uptake due to the COVID pandemic.

In Figure 15, we give an impression of the context by presenting the various New Mobility modes and public transport, both of which are key ingredients of MaaS. Note that the overview is a snapshot of the situation in December 2020 and is mainly based on desk research and estimations and information from interviewees. The figure emphasises the presence of mobility providers and the diversity within each case study.

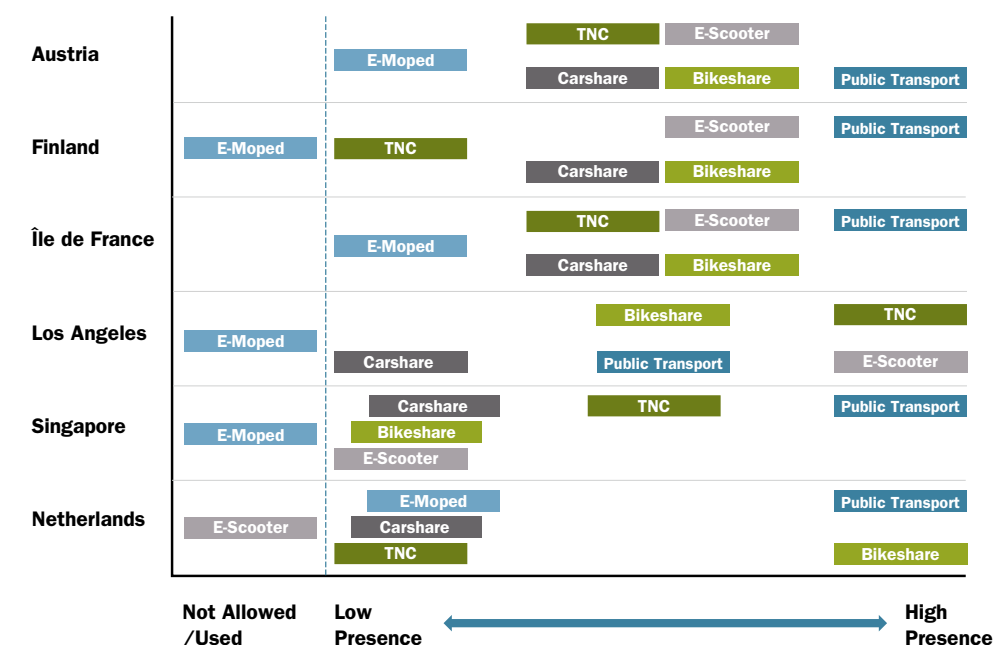


Figure 15 Presence of new mobility options and public transport

In Singapore and Europe, the public transport systems are well-developed. There are also strict entry regulations for New Mobility Services. MaaS is valued in Europe as an opportunity to develop New Mobility options, integrate them and contribute to societal goals through this. The uptake of New Mobility Services, as well as integrated MaaS offerings, is generally low in Europe. In the US and Singapore, the deployment of New Mobility options by private parties took off rapidly, causing problems at first – yet after public action, the role of private parties was also acknowledged.

4.3 GOALS, MOTIVATIONS AND DESIRED OUTCOMES

The largest similarities between cases are the acknowledgement that MaaS can contribute to sustainability and improve mobility system efficiency, as well as improve user comfort, seamless travel, flexibility and affordability. The differences were the emphases on economic goals (i.e. reacting to a taxi market threat in Los Angeles and seizing an opportunity in Finland) and social equity (very dominant in the Los Angeles case compared to the other cases). The goals also differ greatly at the systems level to which they apply (see Table 3). All cases have goals formulated at the top three levels. The exceptions are Singapore, which does not seem to have MaaS or New Mobility-specific goals, and Île-de-France, the Netherlands and LA, which seem to cover the entire spectrum. Perhaps not coincidentally, we also found the most effort on research and learning in these cases. Overall, it seems that the goals around structural building up of knowledge and expertise is lacking, especially as there is still much to be learned given the early stage of MaaS development. Hardly any cases have monitored the impacts on societal goals. However, the Netherlands and Los Angeles are working to put monitoring in place (upfront) in order to be able to measure and steer impacts on societal goals (in a later phase).

Table 3 Various societal goals

	Sustaina- bility	Accessi- bility	Efficiency	Social inclusion	Level playing field	Other
Austria						Affordability
Finland						Promote Finish companies
Île-de-France						Promote innovation
Los Angeles						
Singapore						
The Netherlands						Various goals to enhance learning

4.4 INSTITUTIONS

The specific institutional context explains why certain elements of MaaS receive more attention in one case over another.

- Finland: lack of venture capital in Finland; stronger taxi regulation than the rest of the EU; Ministry is in charge of both mobility and digitalisation; Ministry is not organised in verticals per mode.
- France: national and city regulations need management; IDFM is institutionally empowered for MaaS.
- LA & Singapore: modes organised in verticals (per mode).

- Singapore: strong regulation regarding the use of public transport and decreased use of cars (congestion charge); New Mobility options (e-scooters and bikes) are regulated reactively in the case of problems.
- Austria: change of national government led to radical/overhauled change in MaaS strategy.
- Netherlands: need for an integrated mobility approach; bike-loving country; many MaaS start-ups; limited uptake of sharing and MaaS propositions before national scalable pilots; strong PTO parties and PTO and taxi regulation.

Table 4 gives further insights into the public institutions and regulations in place.

Table 4 Public institutions and regulations in case studies

Public institutions and regulation	
Austria	Ministry has powerful role, have influence on national railways. Government change has changed the strategy. From specific MaaS program with pilots focus shift to strengthening nationally organized public transport.
Finland	Ministry set new legislation enabling new mobility services and facilitates development of MaaS network but does not set standards and does not take role themselves. Transport agency implements rules and checks compliance of stakeholders to regulation.
Île-de-France region (Paris), France	Île-de-France Mobilités, the regional Transport authority takes very powerful role by initiating development of MaaS ecosystem with standard setting, building app, integrating transportation service providers and promoting public-private cooperation. IDFM coordinates with local, regional and national government and aligns their regulations.
Los Angeles, USA	LADOT is organized in verticals which leads to some sectors being farther in development than others (e.g. MDS applied for scootersha- ring, not for other modes). LA Metro has own strategy and collabora- tion is limited. Some modes (e.g. TNCs) regulated at state level.
Singapore	Land Transport Authority (LTA) is organized in verticals. MaaS is not a specific topic. Public transport providers are focus point. Road pricing. Regulation of new modes/services takes place after problems occur.
The Netherlands	Ministry of IenW, regional authorities and municipalities are organized in verticals with a focus on public transport and road transport (transport modality). MaaS is seen as an opportunity to optimize on integrated mobility (via data) on societal goals.

4.5 STAKEHOLDERS AND INTERESTS

In all cases, the MaaS ecosystem generally consists of a large number of stakeholders (50+). In the figure below, we have listed the key stakeholders that steer MaaS development. Developing trust between public and private stakeholders as well as between different government agencies and within different scales of government is important to facilitate MaaS development (cities are also important stakeholders, for example). The key stakeholders found in the case studies are public authorities (PA), public transport operators (PT), New Mobility service providers (NMSP) and MaaS service providers (MSP). There are clear differences between cases as to which stakeholder has taken the lead in developing and steering the MaaS ecosystem. Consumer organisations did not play a central role in any of the cases studied. This could be because these organisations are often also organised along mobility verticals (private car, public transport, etc.) and due to the innovative character of MaaS. In Table 5, the key stakeholders shaping the MaaS ecosystem are represented; for each case study, the following classifications are given: lead stakeholder (dark blue), actively involved stakeholder (light blue) or stakeholder playing a smaller role in the ecosystem (white).

Table 5 Key stakeholders in the MaaS ecosystem

	Public Authority	Public Transport Operator	New Mobility Service Provider	MaaS Service Provider
Austria				
Finland				
Île-de-France	= Maas Service Provider			
Los Angeles				
Singapore				
The Netherlands				

In Austria, the public authority was working on organising the market, facilitating network development and steering public transport towards an active role but has now changed strategy, putting all efforts into getting the national railway to a powerful position. In Finland, the national government facilitates (and has initiated activities) and gives room for MaaS service providers to develop MaaS services. In Île-de-France, the transport authority takes a very active role, implementing and developing the MaaS platform and app themselves and taking on the integrator role. In LA, the public authorities set clear standards and requirements

and steer but let the New Mobility service providers (TNCs and e-scooters) innovate and develop the services. In Singapore, the government regulates New Mobility service providers and gives room for MaaS service providers to develop MaaS services with public transportation as a backbone; the MaaS service providers are active in implementing the MaaS apps. In the Netherlands, the Ministry is leading the way for both New Mobility service providers and MaaS providers that were stimulated to cooperate in the MaaS ecosystem. Table 6 gives a detailed overview of the key stakeholders in the case studies.

Table 6 Overview of key stakeholders in the case studies

Stakeholders	
Austria	Ministry, AustriaTech, ÖBB, Wiener Linien. PT providers offer MaaS platforms (activated by public funding). Private providers collaborate with them to be on platform.
Finland	Ministry, Agency, MaaS Global. Public is not offering services themselves but facilitate collaboration and facilitate growth of new private players. MaaS apps are offered by private players.
Île-de-France (Paris), France	IDFM. Cooperation between regional authority (IDFM), public transit providers and a variety of private parties.
Los Angeles, USA	LADOT and LA Metro. Public sets requirements and standards. Private party and publicly owned PT offer products. TNCs and new mobility service providers.
Singapore	LTA, MobilityX. Public authority steers towards large role of PT. MaaS apps are offered by private players.
The Netherlands	Ministry of Infrastructure and Water Management with 7 regions. Public sector is not offering services themselves but facilitate collaboration and facilitate growth of new private players. Development of 7 MaaS apps as part of the execution of 7 national scalable pilots, and a number of other MaaS apps.

4.6 MARKET STRUCTURE AND CHARACTERISTICS

In the cases besides LA, (market entry) regulations needed to be changed in order to open up the market to New Mobility providers. The markets for New Mobility Services (wheels on the ground) and MaaS services (via a platform) are currently generally rather small and in development. MaaS requires a rather large market (in terms of users) in order to achieve the economies of scale that create a viable business case. Public transportation providers can be a barrier to entry as they sometimes see MaaS services as competition (if those services are not directly offered by the public transportation providers themselves).

In the cases studied, the actors that provide the MaaS app differ (see Figure 16). In Finland and Singapore, this is provided by private sector, MaaS service providers. In the Netherlands, this is provided by private sector MaaS service providers that consist of consortia of different private companies. In Île-de-France, the regional transport authority provides the MaaS app. In Austria, the MaaS apps are provided by the public transport companies. In LA, early versions of a MaaS app are being developed by the regional public transportation authority while the private sector has developed their own 'walled garden' apps that limit access to only a few affiliated companies.

Private Sector MaaS service provider	MaaS service provider consortia: cooperation private companies	Regional transport authority	Public transport company
<ul style="list-style-type: none"> – Finland – Singapore – Los Angeles 	<ul style="list-style-type: none"> – The Netherlands 	<ul style="list-style-type: none"> – Île-de-France – Los Angeles 	<ul style="list-style-type: none"> – Austria

Figure 16 Actor that provides the MaaS app

Table 7 gives more insight and details on how the market structure is built up.

Table 7 Market structure of case studies

Market structure	
Austria	MaaS market strongly based on PT. In Vienna large supply and use of new mobility services and integrated well on MaaS app by PT provider. New strategy of national government wants to put ÖBB (PT, national railway) central in market.
Finland	Public facilitates, private parties innovate and develop. Public transit is hesitant to new services and integration.
Île-de-France region (Paris), France	IDFM wants to structure the whole mobility market and implement MaaS. IDFM makes use of pilot projects to develop their service proposition and (most) private players cooperate.
Los Angeles, USA	Supply and use of new mobility services is large and growing. LADOT approaches new mobility services separately and cooperation with LA Metro is limited.
Singapore	The publicly initiated MaaS app that was developed during piloting was turned into a private company developing the MaaS app further for the whole of Singapore. Currently PT focused, limited TSP integration.
The Netherlands	Public convenes and coordinates, private parties innovate and develop. Majority of public transport companies are exploring MaaS, some are hesitant towards integration (including data sharing and ticketing).

4.7 POLICY AND STEERING

Cases show a variety of policy instruments that are applied. The main focus is on financing pilots, services & platforms and access/regulation to ensure a level playing field. However, many cases have a considerable number of accompanying governmental actions to promote the MaaS ecosystem (as can be seen in Table 8).

Table 8 Policy instruments applied in cases

	Austria	Finland	Île-de-France	Los Angeles	Singapore	The Netherlands
Financial support						
Facilitate cooperation						
Standards						
Regulation of market access						
Data sharing agreements						
Pilots						
Information & marketing						
Research						
Regulation on public space						

The fact that the main focus of the policies lies on a diverse set of steering is probably related to the fact that all cases are still in the early phases of development. Currently, policies focus on growing the deployment and use of MaaS. It is expected that more targeted steering options will come into play when the MaaS system is (more) mature (e.g. a large range of shared modes are offered, MaaS platforms are in place and more widely used). At that point, government action could play a stronger role in steering towards societal goals. In the Netherlands, the aim from the start has been to be able to explore steering towards societal goals. For LA, this was not the starting point, yet the policy approach was developed with eventual steering in mind (with MDS). As for now, for all of the cases studied, it is too early to indicate the impacts on societal goals based on the policy instruments in place.

Table 9 gives further insights into specific instruments that have been applied in order to steer on MaaS.

Table 9 Policy and steering: specific instruments applied

Policy & Steering	
Austria	Had pilots and experiments running to develop MaaS. Facilitated cooperation between stakeholders and discussions for standard development. Now empowering PT provider to take active role.
Finland	New Act on Transport Services enabled new services and forces open data. Facilitation of network building. Investments in new players. Pilots on new mobility concepts. Not setting exact standards.
Île-de-France region (Paris), France	Regional and national government set goals. Transport agency have 'Guide de Référence for building ecosystem. A number of pilots are used to develop standards, further development of the MaaS app and ways of cooperation.
Los Angeles, USA	Regulation of taxis. Data sharing standard - MDS. Incentive structure for steering towards societal goals in development.
Singapore	Strict regulation towards PT use, de-incentivizing car use Overarching program for smart mobility with PT as backbone. Strict regulation after problems with bike- and scooter-sharing.
The Netherlands	Strict regulation on PTO and taxi. Decentralized regulation on new and shared mobility (by municipalities). Competition law, regulated by the Netherlands Authority for Consumers and Markets (ACM), they ensure fair competition between businesses, and protect consumer interests. 7 pilots on MaaS in development with startup subsidy from the government. Framework agreement for all stakeholders involved in the pilots containing principles for fair and open ecosystem. The goal of the pilots is to see which of the principles from the pilots work and which don't and to set regulation based on the pilot experience and impact. Government facilitates development of standards.

5 LESSONS LEARNED

The lessons learned from this independent comparative case study on the governance of Mobility as a Service (MaaS) are structured along four lines: (1) broad impressions on the state of MaaS development as studied in the cases, (2) lessons learned on the governance and steering of MaaS, (3) the drivers and barriers of MaaS development and (4) an outlook on the next steps for MaaS and the further development of the knowledge base. We hope that the lessons learned from this study have relevance (beyond the cases studied) for all public authorities (from municipalities to national governments) as well as for all other stakeholders involved in the MaaS ecosystem.

5.1 MAAS DEVELOPMENT

MaaS is still in the early stages of development

MaaS, as a concept, has been around for a decade; however, developments take time and substantial effort, as is generally the case for the implementation of emerging technologies (Schroten et al., 2020). Although MaaS has been highly touted and advances are highly publicised, it is still in the early stages of development. The reality is that MaaS apps, ecosystems and governance are generally very much in their infancy. The reasons for this vary by region but include issues such as a small number of New Mobility providers in regions, a lack of mode variety available in regions, a lack of vision and cooperation between key stakeholders on MaaS development, a lack of MaaS apps developed and operating and/or a lack of uptake by users even when all this is in place.

All of the cases studied primarily focussed on creating base conditions for MaaS development

Creating the base conditions that allow MaaS to develop includes broadening the number of New Mobility providers and modes offered, developing payment standards & developing data standards & sharing requirements and developing MaaS apps (the apps which integrate finding, booking and payment services across modes). These base conditions are needed to be able to reach large-scale deployment and user adoption, as well as for MaaS to contribute to societal goals. The build-up of base conditions in all cases studied is ongoing; focus is needed on removing barriers to enter markets, legislative support actions and the development of data standards, data sharing requirements, interoperability and harmonisation (for examples, see 4.7).

There is low uptake and utilisation of fully running MaaS services

This is partly due to limited implementation (the availability of MaaS apps; New Mobility and other options in MaaS apps; find/book/pay services in MaaS apps) and partly due to the public not yet embracing MaaS. Some regions are trying to instigate New Mobility Services and bring them into existence or expand them (i.e. the Netherlands); others have a lot of them already and are trying to understand how to control them so that they do not take over the mobility system (i.e. LA and Singapore). The few MaaS apps that have a large numbers of users have most usage focused on a single mode and not on a broad use of all the modes available in the MaaS apps. For example, users are utilising MaaS apps for public transport but are not yet expanding to increase their use of the full range of modes available on these apps. For instance, the primary MaaS app in Austria is predominantly used for public transportation while in the US walled gardens focus on ride-hailing and have minimal use of other offered modes (such as public transport).

Each case follows its own transition path on MaaS development and uptake

This is not to say there have not been advances in MaaS or that the future for MaaS is dim. All cases studied follow their own transition paths as each MaaS ecosystem is unique. MaaS development and uptake is highly dynamic (with COVID-19 adding to the dynamics, both positive and negative), resulting in a continuously changing landscape. Each case therefore has its own complicated MaaS ecosystem, a great variety of stakeholders involved and its own organisation. Lessons learned should be translated such that they fit the local context.

5.2 MAAS GOVERNANCE AND STEERING**Public authorities have important yet very different roles in steering MaaS**

Across the world and specifically in the cases studied, we see a great variety of stakeholders (see 4.5). The primary actors driving MaaS range from regional/national public authorities and public transport providers to New Mobility service providers and MaaS service providers. The ways in which these actors interact also differ. In some cases, the public authority is the driving force behind the launch of MaaS (i.e. Île-de-France); in other cases, they facilitate MaaS but are not the executing actor (i.e. Finland, the Netherlands). The executing actors differ from traditional actors such as public transport authorities, New Mobility service providers and other private companies. One way or the other, we do see that public authorities can have an important role in steering MaaS (either from a more proactive or more reactive standpoint, see 4.1), including regulation, coordination and steering. Yet to date, these actions have been limited. Given the early stage of development and uptake, the benefits of one stakeholder versus another in driving MaaS development are still unclear. Public transport providers and New Mobility service providers (in the US) hold the promise of a large number of users but also pose the threat of creating transportation monopolies that stifle innovation and constrict market entry. Public authorities can act as more neutral parties, creating a more open market, but can stifle private sector investment, innovation and development if they overregulate. We speculate that well-formed public/private sector collaborations may eventually prove to be the most effective strategy. These can help foster broad development and, at the same time, steer towards societal goals.

MaaS requires tailored public strategies

Each case study's starting point, context, culture, and the phase of development concerning MaaS is different. Even the set of goals that the cases strive for are different (see 4.3). We can therefore see that MaaS requires a tailored approach when it comes to public strategies. Some countries, regions and cities responded to pressure from New Mobility providers, i.e. TNCs, with strategies specific to those market actors (i.e. LA and Singapore). Others see opportunities and focus on facilitating MaaS, i.e. attracting investment capital for MaaS and starting pilots and programmes (i.e. Finland – investment capital, Austria, Île-de-France, Singapore, the Netherlands – pilots and programmes). There is no one size fits all: the ecosystem that is already in place and the gaps in that ecosystem define the required steps forward in a region. It is important to have a strong understanding of the full range of MaaS ingredients (e.g. New Mobility options, public transport, MaaS platforms, data, steering towards societal goals, uptake) needed for a healthy ecosystem, an understanding of what is lacking in a region, an assessment of a public authorities' standings in the development of those ingredients and policy that supports the overcoming of barriers and/or protection against actions that run counter to societal goals (this is also illustrated in the MedMij case). Governance is most effective when it fills gaps in the development of MaaS in a region.

Public authorities use and experiment with a wide range of policy instruments to develop MaaS

Public authorities use a range of policy instruments to develop MaaS. In the cases studied, we came across the following: subsidies, facilitation of cooperation, standardisation, regulation of roadway access, data sharing, pilots, public support, information & marketing, research and spatial instruments. As stated previously (see 4.7), the main policy instruments in the cases studied are the financing of pilots, services, MaaS platforms and apps and access regulation to ensure a level playing field.

One thing that is clear is that on their own, the policy instruments will not lead to an effective steering strategy. MaaS can be a means to contribute to the policy and societal goals, yet requires a proactive approach to governance from the start. We also see that the mechanisms for steering are still not very clear – both in terms of a general understanding of the range of possible policy instruments (regulatory, financial, facilitative or otherwise) and the utilisation of each of these policy instruments (will they work? how effective are they?). Given the limited experience with MaaS to date, this is understandable. However, before large uptake or a winner-takes-all situation can occur, a clear strategy on governance and steering towards societal goals is needed. In the cases studied, we see no (or almost no) direct steering towards uptake (targets on the use of the app, etc.). The same is true for direct steering towards societal goals. This does not mean that governments do not have societal goals in mind (they all seem to) or do not have the intention to steer on the basis of societal goals (they all seem to) or have not started steering (some of them do, such as Île-de-France and the Netherlands), but rather that they have not developed, implemented or applied the mechanisms to impact those goals. This emphasises the key point that to have a societally-beneficial MaaS ecosystem in place, you need programmes/markets to be up and running first. That said, some are putting elements in place (i.e. the development of data standards and data sharing requirements by LADOT in Los Angeles and the Ministry of IenW in the Netherlands) for an eventual rollout of steering mechanisms. The development of MaaS steering must absolutely be thought of as a long game with many short-term actions that can build toward the eventual fulfilment of societal goals.

There are large differences between the cases in the set of policy instruments that are applied and the policy instruments that are in development. Public authorities experiment with (combinations of) policy instruments in order to learn more about their effectiveness and then tailor their actions to the phase of MaaS development. Public authorities therefore need to develop a steering strategy consisting of policy packages for MaaS. This requires a broad set of policy actions in order to further steer the development of MaaS and an assessment on what is in place, how effective the strategies are and what needs further attention.

Public-private cooperation is key

All cases studied have a large ecosystem with many stakeholders involved in the development of MaaS, and every case shows that public-private cooperation is key. This takes trust-building between private and public players as well as trust between different public players and between incumbent and new players. Important preconditions are openness in the process, the protection of core values and fact-based data and information sharing (De Bruijn, ten Heuvelhof and in 't Veld, 2002).

It is crucial to organise cooperation between all relevant stakeholders; the development and deployment of MaaS, starting with the creation of base conditions, requires the close involvement of all relevant stakeholders in order to ensure that actions are consistent and aligned. Furthermore, close cooperation may enlarge the innovative capacity of the transport sector, accelerating the development of MaaS. It is crucial that a representative selection of (different categories of) stakeholders are included. This requires stakeholder management to ensure that stakeholders who are not (well) represented are actively invited and, if necessary, (financially) supported. This ensures that not only large but also smaller interests are brought to the table. Specific attention is needed in order to include end-users and consumer groups in initiatives that facilitate cooperation, as a clear understanding of their needs is required to develop applications that will be taken up by the market. This has been largely absent in the cases studied. Cooperation and consultation bodies should therefore be organised and/or prolonged and/or extended regarding the various aspects of MaaS (Schroten et al., 2020). We speculate that well-formed and balanced public-private sector collaborations that are tailored to the context and culture, as well as a strong level of trust, may prove to be the most effective strategy for accelerating MaaS development. This can ensure end-user benefits while also steering towards societal goals.

5.3 DRIVERS AND BARRIERS OF MAAS DEVELOPMENT

MaaS strategies should include actions to align with drivers and overcome barriers

The drivers and barriers of MaaS can be categorised differently for the public sector, the private sector and end-users (Araghi et al, 2019). Here, we focus on the drivers and barriers that stand out in the cases studied.

Drivers

The main *drivers* of MaaS development are the wide variety of *goals and motivations* behind the development of MaaS (see 4.3). All cases include a set of goals related to public, private and end-user interests. The cases focus on the development of MaaS, as well as how MaaS can contribute to societal goals. However, there are many differences in the precise focus on societal goals within the cases studied. The monitoring of goal outcomes is often lacking but can strengthen development. Some cases have put efforts in place up front (i.e. LA and the Netherlands), but implementation is yet to be tested.

Barriers

The main *barriers* to MaaS development are the lack of development of an integrated approach, a lack of trust between key stakeholders, monopolistic behaviour, a lack of fact-based data and information sharing, an unlevel playing field, difficult entries to markets and difficult scaling of MaaS uptake.

We find a lack of *integrated approaches* and a challenge in keeping this on the table in the cases studied. This is influenced by the silos in government (public authorities are often organised in a sectoral manner) as these play a critical (at times, limiting) role. There is occasionally a lack of cohesive strategy or public sector actions simply because the agency (or department) which is leading the effort has a limited jurisdiction and focuses on sectoral goals. We also see silos in the mobility field as a whole. There is often limited interaction between agencies steering on public transport and the New Mobility providers. There is lack of trust or transparency between private sector actors as well. MaaS is a means to reach societal goals; however, it also asks for cross-domain integration and cooperation. Open communication and trust are a must for this to occur. There is often a lack of ambition to focus on integration among key stakeholders in the MaaS ecosystem.

Monopolistic behaviour relates to one (or a few stakeholders) with a dominant position in the MaaS ecosystem. In some cases, we see a focus on public transport as the backbone for MaaS (i.e. Singapore) and public transport operators as natural MaaS platform leaders (i.e. Austria). This can cause conflict as public transport is sometimes seen as a player with monopolistic desires. Dominance by private parties can also lead to monopolistic behaviour, the so-called 'walled gardens' often run by TNCs. In the end, there are three potential end-situations: a public transport provider winner-takes-all walled garden, a New Mobility service provider winner-takes-all walled garden or an open ecosystem level playing field. Each of these has benefits and challenges. There is a role here for governmental steering related to market structure and dominance, a role for private partners to bring in innovation capacities and position the end-user centrally and a role for both to find ways that challenge end-users to shift their mobility behaviour and start using MaaS.

The lack of *fact-based data and information sharing* is a third key barrier to the development of MaaS. The best strategies for the data standards and data sharing requirements are not exactly clear. We have seen that this is not being developed similarly in different places. In some cases, the government is organising this (i.e. Île-de-France, Singapore, the Netherlands); in other cases, private actors play a larger role (i.e. Austria, LA). It is also unclear if and which combination of a carrot and stick approach is needed to make parties actually share data with each other and with governments. It is vital to organise data and information sharing as an important starting point that should be in place to measure, learn and understand whether MaaS is contributing to societal goals.

An unlevel playing field and difficult entries to markets could be major barriers to MaaS. In the MaaS ecosystem, there needs to be sufficient room for New Mobility service providers to enter the market. More service providers means more options for users and a constant, competitive push to improve service offerings. Furthermore, a broad level playing field ensures that all stakeholders receive sufficient room to innovate, not only the largest and most established players. This requires a balance between incumbents and new actors, from start-ups to international companies and from inside and outside the mobility sector. Depending on the local context and culture, this requires tailor-made policy actions. And when a market is in place, a viable business case still needs attention. The question of the business model is still on the table. As one of the interviewees stated: "how to create a system that only subsidises when needed from a societal perspective?" Again, this is about finding the optimal balance between public players, private parties and end-users.

Finally, the *scaling of MaaS uptake* is a real challenge. The ecosystem is dynamic, services are cut and cancelled if they are not profitable, are poorly managed or do not match the local ecosystem. A lack of travel demand is more uncertain and topical than ever (due to the COVID pandemic). The creation of a viable business case that contributes to positive societal outcomes is key. It is also vitally important to stimulate users to try MaaS services and embrace New Mobility behaviour. Taking the next step from a pilot to a mature MaaS platform calls for an upfront strategy and well-organised public-private cooperation.

5.4 MAAS OUTLOOK

Shaping the entire MaaS ecosystem requires effort, long-lasting dedication and patience

Some programmes are looking at the long term and are focused on societal goals, on creating a robust ecosystem and on data standards and data sharing requirements. The building blocks are increasingly in place but still there is much to develop and learn. This will require effort, long-lasting dedication (i.e. continuity in programmes) and patience.

As MaaS is innovative, its future development is difficult to predict. Policies therefore need to be proactive, flexible and adaptive in order to be able to steer towards societal goals. It is important to develop policies in such a way that when new stakeholders arrive, New Mobility Services emerge or the context changes so that a quick adaption of policies is possible. Putting learning and monitoring in place helps to keep track of state-of-the-art developments and progress on societal goals. In turn, this can help determine when action is needed.

Looking ahead, a strengthening of the knowledge base on MaaS is critical

This study aims to contribute to the global discussions and knowledge exchanges on MaaS with a focus on governance, policy and steering. Of course, the technical backbone needs to be in place; however, this is no guarantee of success. Progress on state-of-the-art knowledge on governance, policy and steering is needed. The priority should be given to developing knowledge on:

- 1) implementing mechanisms to track the contributions of MaaS to societal goals.
- 2) mapping the institutional setting in order to define roles and responsibilities across public agencies.
- 3) balancing the ecosystem and organising public-private cooperation in close connection with the end-user.
- 4) business models that reduce both government and market failures.
- 5) the development of policy packages on the value case that result in the effective steering of MaaS with the end goal in mind.

The development of MaaS will take substantial efforts and collaborations in both the public and private sectors if it is to succeed in terms of uptake and societal goals. The potential future for MaaS is bright and open-ended. Many actors across the globe are striving to develop and define this, which is a great opportunity for testing, sharing and learning. And we are just at the beginning.

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APPENDIX 1

MEDMIJ HEALTHCARE CASE



Context

- MedMij is a Dutch healthcare initiative and was studied as an adjacent case for this MaaS study.
- Just like mobility, healthcare is faced with digitalisation and technological advances that have the potential to shape the future of the sector.
- Approaches and insights from the MedMij case could be applicable to the development and governance of MaaS (e.g. lessons on public-private collaboration, user needs, data standards & APIs, safeguarding public interests).



Highlights

- MedMij is a healthcare agreement framework for the safe exchanging of healthcare data between healthcare professionals and patients. MedMij has certified over 50 companies to comply with the agreements within the framework.
- The starting point of MedMij is the ability for patients to take control of their health. The Dutch patient association emphasised this need and initiated the development of MedMij.
- The Ministry of Public Health, Welfare and Sports actively facilitates this development. Development is taking place with all relevant stakeholders.



Timeline

- 2015: Report on patient needs for control over their own health → starting point of MedMij
- 2018: Establishment of the MedMij Foundation and independent board
- 2016 – now: MedMij developing, taking shape and certifying over 50 companies within the agreement framework



Goals, motivations and desired outcomes

- Patients taking control and ownership of their own health.
- Digitalisation of the healthcare sector.
- Offering the best healthcare services possible and the enabling technology to do so while maintaining the highest standards in terms of privacy and trust.



Strategy and approach

MedMij is a foundation initiated by the Dutch patient association that brings together all relevant healthcare stakeholders in order to work towards an agreement framework that all healthcare platforms and services should adhere to. The Ministry of Public Health, Welfare and Sports (VWS) facilitates the development of MedMij by hosting the 'roundtable' conversation structure (with representatives of each relevant stakeholder group) and enabling the patient association to carry out this task financially (50% funded by the ministry, the other 50% by health insurance companies).

The outcomes of these processes are:

- An agreement framework with a certification structure.
- A maintenance organisation to keep MedMij up and running.
- Open APIs and standards (based on international healthcare and data standards and best practices).



Institutions

The Ministry of VWS deliberately chose not to build a public platform, as healthcare in the Netherlands is a public task carried out (mostly) by private parties. MedMij is therefore not a part of the national government but a foundation. The role of the Ministry is facilitatory.

- Patients' Association (representing the needs of patients and initiating MedMij)
- MedMij Foundation with an independent board
- Ministry of Public Health, Welfare and Sports (Ministry of VWS)
- Municipalities



Policy and steering

- MedMij agreement framework with certification structure.
- Ministry of VWS can steer by making the agreement framework obligatory and only allow subsidies to parties that comply.



Stakeholders and interests

- Patients' Association (representing the needs of patients and initiating MedMij).
- MedMij Foundation with an independent board: running MedMij, resolving issues and making sure that the decision-making and operations of the agreement framework are adaptive and accurate regarding patients' needs and societal changes.
- Ecosystem stakeholders:
 - Ministry of Public Health, Welfare and Sports (Ministry of VWS)
 - Municipalities
 - Health insurance companies
 - Hospitals, general practitioners, physiotherapists
 - Pharmacies
 - Care facilities for the elderly, handicapped or long-term ill
 - IT parties and third parties developing healthcare services and platforms



Market structure and characteristics

The Ministry of VWS is facilitating the development and operations of the MedMij Foundation and its agreement framework. The agreement framework and the corresponding maintenance organisation are the outcome of a roundtable conversation structure in which all relevant ecosystem parties are represented (except from the IT side; those were included in a second order conversation structure as contractors from the roundtable). MedMij works with a certification structure to allow third parties to join. Over 50 companies have joined MedMij and have complied with the agreements in the framework.

MedMij's initial starting point and development

The Dutch Patients' Association addressed the need for control of patients' own health and for gaining better insights into what one can do to improve their own health. This resulted in a project called the Personal Health Record. In this project, the full spectrum of patient needs was assessed, ranging from needs in the case of an acute cancer diagnosis to needs regarding a long-term illness or handicap. They tried to answer the question on what it means to have more control of your own health and how technology could help support this need. They derived a list of functionalities involving the disposal of one's own data, allowing third parties to create services based on that data and securing results in healthcare processes. These results were drawn up in a report in 2015, which was the starting point for MedMij (MedMij, 2020).

Platforms versus an agreement framework

One of the barriers to MedMij was scaling up the initiative. Initial thoughts were on supporting three (already operative) market initiatives (platforms) and financing them in order to develop them to the point of scaling. This possibility was discussed with the stakeholders in the ecosystem: the Ministry of Public Health, Welfare and Sports (VWS), patient associations, general practitioners, pharmacies, hospitals, insurance companies, physiotherapists, municipalities and the national government. Together, they agreed that if you want to support the developments in MedMij, you need to facilitate the ecosystem rather than the platforms. It is not about the platforms and what they can do (technically) but about the flexibility for patients to find which services suit them best. They therefore agreed to not build or finance technological platforms but to create an agreement framework that all platforms and services should comply with.

Breaking through barriers

An important barrier is that information on health is very private and highly sensitive. This data is often not accessible: healthcare works in silos and the integration and sharing of information is a problem. MedMij set up a trajectory to unlock data for patients via portals. In order for that to be safe, the agreement framework should take care of questions such as: how do you reach your data? How to make sure that user authentication is in order and patients only see their own data? How to make sure that data cannot be altered when shared? How to make sure that you only communicate with your own doctors and not the entire hospital? In short, how to make sure that the privacy standard is of the highest quality and that trust in MedMij is very high?

Public steering and interference in the MedMij development

As the Dutch healthcare sector is privately organised, the Ministry never considered creating a public platform. MedMij, however, does safeguard public values as these are introduced by the Ministry and other public organisations during the consultations at the roundtable. The Ministry positioned MedMij as part of a wider digitalisation strategy with broad political support resulting in availability of substantial subsidies (carrots). If needed the Ministry can make standards obligatory through regulation and only give out subsidies when standards are adhered to (stick). They are then still able to steer, although their role is not hierarchical but facilitatory for the stakeholders and the ecosystem.

The Patients' Association - which is 50% subsidised by the Ministry of VWS and 50% by health insurance companies – was appointed to lead the process of MedMij development. They are therefore not only representing their own interests but navigating the entire ecosystem. The Ministry had a clear vision on the level playing field required, their own facilitating role and necessity to set up a roundtable consultation structure (called the 'Informatieberaad') to develop the ecosystem, which is chaired by the Secretary General of the Ministry of VWS and in which representatives of all relevant stakeholders participate. This roundtable is the collective client for IT specialists and has its own steering group. It resulted in the agreement framework and a maintenance organisation that keeps MedMij up and running.

MedMij is organised as a foundation with an independent board in order to make sure that decision-making is not hampered by the numerous stakeholders represented in the roundtable. This also helps make sure that the platforms themselves are dynamic enough to adapt to changes in society and to make it possible for third parties to offer personalised services for the benefit of patients. The roundtable utilises a working group structure in order to resolve issues around various topics such as standards, governance structures, agreements on technical issues, requirements for technological partners and issues on privacy and legal aspects.

MedMij uptake

MedMij works with certification in order for partners to join the agreement framework. Over 50 companies have joined and more and more patients are using the services offered through MedMij agreements. Parties that have joined MedMij are both big and small. Important for the further development is the continuous attention to progress through monitoring using a yearly E-Health monitor and regular update letters to parliament. MedMij is the first national agreement framework in healthcare. Other countries, such as Denmark, Sweden, Finland and France, also have a national portal. A unique property of MedMij is that patients themselves dispose of their data and have ownership. MedMij works with international standards (standards for both healthcare and data) and is based on international best practices. This supports the future option to scale up internationally.

Relevance of MedMij to MaaS development

The case of MedMij was studied as an adjacent case to MaaS development, for which some similarities have been found in terms of context and drivers and barriers. For example, they both face digitalisation of the sector, future solutions take place in platforms, data plays an important role and both have the ability to fulfil public needs or goals. In the Netherlands, both the healthcare sector and the mobility sector have private parties that are responsible for carrying out a public task. Also, strategies and considerations on the development of MedMij could be applicable to MaaS development – do you focus on the development of platforms or do you create an agreement framework (collectively with the private sector and user associations) that sets the standard that each of the platforms needs to comply with? What level of public steering are you aiming for? Furthermore, arranging a ‘mobility roundtable’ consultation structure might help to shape and steer the ecosystem and gain insights into the interests and needs of different parties. In addition, monitoring proved an important building block. There are also differences, such as the fact that it should be easier to make mobility data more open since it is not at the same level of privacy and sensitivity as healthcare data. From the MedMij case it is hypothesized that applying a carrot and stick approach may speed up the development as well as the quality of the outcomes. Breaking through the data monopoly is an important step forward. Work with open APIs and standards can also be learnt from MedMij.

APPENDIX 2

LIST OF CASE STUDY RESPONDENTS

The following respondents have been interviewed for each case study:

Case study	Respondent (name en organization)
Austria	Franz Schwammenhöfer, Federal Ministry for Transport, Innovation and Technology Michael Lichtenegger, Upstream
Finland	Saara Reinimäki, Ministry of Transport and Communications Laura Eiro, ITS Finland
Île-de-France region (Paris), France	Olivier Vacheret, Île-de-France Mobilités Benoît Boute, Île-de-France Mobilités Cyril Aillaud, Île-de-France Mobilités
Los Angeles, USA	Jarvis Murray, Los Angeles Department of Transportation Joe Iacobucci, Sam Schwartz
Singapore	Wee Meng Lim, MobilityX Timothy Toh, Land Transport Authority
The Netherlands	Eric Mink, Ministry of Infrastructure and Water Management Liselotte Bingen, Ministry of Infrastructure and Water Management
MedMij	Ron Rozendaal, Ministry of Public Health, Welfare and Sports Herko Coomans, Ministry of Public Health, Welfare and Sports Indra Henneman, MedMij foundation

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