Policies and regulations required for enabling MaaS (ProMaaS). Deliverable 6 - In-progress report. Governance model for European cities, existing technologies and market shares

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Activity Deliverable

20029 – ProMaaS
DEL06 - WP 4 - In-progress report.
Governance model for European cities, existing technologies and market shares

Authors: Valeria Caiati
Helber López

EIT Urban Mobility - Mobility for more liveable urban spaces

EIT Urban Mobility
11/12/2020

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**List of abbreviations**

| WP: Work Package | |
|------------------||
|                  | |
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1. Executive summary

This deliverable builds upon the results of the previous work within the ProMaaS consortium. It delivers a multifaceted analysis of the relevant elements that have an influence on MaaS development and provide a presentation of alternative plausible future mobility scenarios in European contexts, for the advice on policies and governance models that should help to speed MaaS implementation.

This report identifies the pieces of the regulatory framework and define few actions to bring about better conditions for further implementations. The pending work should be able to bring more clarity to the definition of these actions, simulate the decision-making process to understand the effect of those actions, dig deeper into the future scenarios that can unfold as a consequence.

The authors of this document collaborated closely with all the other partners of the consortium to produce a deliverable that represents the position of it as a whole. A 2-day workshop held up during the second week of October enabled a close interaction and discussion of the many positions around the MaaS topic. By the means of systemic analysis and scenario building techniques, the authors were able to organize a process of common understanding that lead to the results presented in this report.

This report is only a starting point to what should be a very clear set of actions to roll up large scale implementations of MaaS in European cities. Amsterdam, Barcelona and Helsinki could profit from it even more, due to the involvement of representatives of the local administrations in the project.

The work so far identifies the limitations of the legal framework across territorial boundaries and the framework for data privacy and security as critical elements to address in the implementation process. When looking at future alternative scenarios of MaaS in Europe, market competition and public support to the development of open data and open APIs are identified as the factors with the highest impact and highest uncertainty in terms of future development of MaaS. Therefore, they are used as scenario dimensions, leading to the creation of the following four scenarios: Mobility Walled Garden, Open Data Power in Standby, Everyone on their own, Open Ecosystem.
2. Introduction

Policy makers continuously face decision-making challenges falling within uncertain contexts. The evaluation of the impacts and acceptance of alternative investments, strategies and policy options requires delineating the future in which they will likely perform (Walker, 2000). Mapping the future is highly demanding, since the possible futures are uncertain. Furthermore, in a fast changing world characterized by rising health and environmental risks, economic instability, growing globalization and rapid technological and social change, it appears uncertainty in policy making has even deepened (Lyons and Davidson, 2016).

In the field of transport policy, the uncertainty is often related to a vast complexity of forces and resulting system changes concerning: (i) the transport system itself, made of travellers, means of transportation, related infrastructures and their interactions; (ii) its outcomes, such as traffic congestion, traffic safety, levels of emissions; (iii) the external forces influencing the demand for transport and the supply of transport, such as demographic change, climate change, technological development; (iv) the set of transport policy actions, related for example to new infrastructures, fuel pricing, stricter regulatory measures for emission reduction, and so forth (Walker, 2000; Jittrapirom et al., 2018).

Uncertainty is also a crucial and inherent characteristic of any innovation. It comes from many sources, namely market conditions, technology, regulatory and institutional environments, and social and political context (Jalonen, 2011). When novel products, services, practices and processes emerge, they might generate new paradigm that impact the current regime, carrying with it new opportunities and risks. Not dealing with innovation-related uncertainties leads to a failure in innovation success.

Mobility as a Service (MaaS) represents an evolutionary innovation (Lyons, Hammond and Mackay, 2019) in the transport sector, expected to induce considerable socio-technical and organizational changes in the current urban mobility system. It has attracted a lot of attention in today’s scientific and policy discourse on sustainable and smart urban mobility. One of its argued benefits is the reduction of private car ownership and usage, with consequent positive effects including decrease in traffic congestion and pollution levels and increase in social inclusion and cities attractiveness (Jang et al., 2020). However, making MaaS a reality is not an easy process. When we look at MaaS as a multi-layered ecosystem consisting of physical infrastructures, a digital infrastructure, market mechanisms, a broad set of stakeholders from the public sector, industry and the civil society, and citizens with their preferences, habits and needs, it becomes spontaneous to think about the emerging array of challenges, in the forms of new risks, uncertainties and consequences arising at the various levels. This creates the need for an effective steering and coordination in the MaaS governance system, which might also imply a profound reform of the current legislative and regulatory frameworks, market conditions and organizational structures in the transport sector to ensure that MaaS implementation leads to the desired environmental and social impacts.

Scenario planning and other future research approaches can play a fundamental role in assessing the future impact of various policy options and governance models aimed at fostering the diffusion process of cutting-edge solutions for a sustainable transport system (Marchau et al., 2013), such as MaaS. By offering possible ways in which the system might change in the future, they offer a testbed for shaping innovation processes.
and governance frameworks, thus helping ensure that the MaaS ecosystem is developed and implemented in ways that encourage sustainable outcomes.

Development scenarios for MaaS have been explored in some recent studies (G Smith, Sochor and Karlsson, 2018; Wong, Hensher and Mulley, 2018). Different methodologies have been used to produce such scenarios, such as literature review and interviews with MaaS actors. Also, different perspectives have been applied for the conceptualization of future MaaS development. While G. Smith, Sochor and Karlsson (2018) investigated the implications for public transport in Sweden under three different scenarios differing in terms of public and private roles in the MaaS value chain, Wong, Hensher and Mulley (2018) focused on temporal and spatial modal efficiency to propose three scenarios for modal development that can be used to inform potential MaaS governance and policy framework. Compared to these previous studies, the present study applies a different methodological approach for scenarios generation and takes business, economical, policy, technological, social, urban, behavioral and supply aspects into account. The scenarios have been built through a co-design process conducted during a two-day virtual workshop in the context of WP4 involving all partners of the consortium. The co-design approach enabled participants, each with their own knowledge and experience on MaaS, to provide a multi-angled understanding of the main drivers, trends and uncertainties expected to shape the future MaaS landscape and to work together in the creation of credible future scenarios for testing strategic decision for MaaS development under a variety of circumstances.

Within the ProMaaS project, the aim of this report is to provide policy makers and local authorities with: (i) an overview of the possible factors that would affect MaaS future development, (ii) a description of the relevant interconnection of the MaaS landscape in the current situation and (iii) a presentation of alternative plausible future scenarios of MaaS in European cities, for the advice on the future-looking governance. The identification of relevant elements for MaaS development has been conducted through a literature review and desk research, while the entire process from validating the key factors, determining their systemic role in the MaaS landscape and developing future plausible scenarios has been conducted in co-design perspective.

Specifically, the current document is structured as follows:

- Chapter 1 presents the executive summary for the outcome of the WP4;
- Chapter 2 gives an introduction about the research subject, its background and an outline of the report structure;
- Chapter 3 comprises of a description of the adopted methodological approach;
- Chapter 4 presents the discussion of the relevant elements that might influence MaaS development;
- Chapter 5 contains information on the systemic analysis of MaaS governance models;
- Chapter 6 describe all the steps of the scenario co-creation technique and present four scenarios about future MaaS development in Europe;
- Chapter 7 outlines the core findings of the deliverable and discusses how these might help policy makers and local authorities in developing appropriate governance models;
- Chapter 8 closes the report with some thoughts on the study limitation and future research perspective.
3. Methodology

The main focus of the WP4 is to provide advice to policy makers on the appropriate governance models taking into account the critical challenges that need to be addressed to move toward a MaaS setting. The definition of a set of plausible future worlds may serve as a basis for assessing how various settings might support or constrain different policies strategies and governance schemes for MaaS development. For this purpose, a systemic analysis and a scenario-based analysis have been conducted.

The adopted methodological approach is summarized in Figure 1. It consists of seven sequential steps involving desk research and workshop activities involving all the project partners, complemented by further analyses conducted by the WP4 leaders.

![Diagram of the methodological approach used in this WP.](image)

The authors of this document collaborated closely with all the other members of the consortium to produce a document that represents the position of it as a whole. A 2-day workshop held up during the second week of October enabled a close interaction and discussion of the many positions around the MaaS topic. By the means of systemic analysis and scenario building techniques, the authors were able to organize a process of common understanding that lead to the results presented in this report.

This draft is only a starting point to what should be a very clear set of actions to roll up large scale implementations of MaaS in European cities. Amsterdam, Barcelona and Helsinki could profit from it even more, due to the involvement of representatives of the local administrations in the project.

The work so far identifies the limitations of the legal framework across territorial boundaries and the framework for data privacy and security as critical elements to address in the implementation process.
The following is a detailed description of the adopted methodological approach.

### 3.1 Literature review and desk research

In the first step, a literature review and a desk research were conducted to gather information about the influencing areas and the relevant factors related to MaaS development. For this aim, a range of sources has been consulted, including academic articles, project reports, policy documents, media articles on MaaS and MaaS governance models. The outcomes of the previous work packages were also analyzed and used to substantiate and extend the collected information. The relevant factors reflect the trends, challenges, drivers, technologies and other elements that have an influence on the development of MaaS. These factors were grouped in nine influencing areas, corresponding to the main layers characterizing the MaaS ecosystem, related to: business framework; policy and legal framework; market and economy; system interfaces and externalities; infrastructure, networks and services; society; urban environment; citizens’ behavior and lifestyle; and global threats.

### 3.2 Workshop

The workshop was held online on the 19th and 20th of October 2020 via Zoom, due to the current Covid-19 pandemic. It was jointly organized and facilitated by the two authors of this report and involved all partners of the consortium. The participants were researchers from various disciplines, practitioners, city and regional representatives from different European countries and with an expertise on MaaS. The main objective of the workshop was to collectively explore the relevant factors, their interconnections and the critical uncertainties expected to have an impact on MaaS development and to interactively co-create four future MaaS development scenarios. These scenarios represent alternative credible futures rather than predictions and are meant to inform the design of appropriate governance models and policies. The workshop activities consisted of plenary and group work sessions designed and carried out on Miro, an online collaborative whiteboard platform where multiple users can draw, work, and communicate interactively.

The workshop started with an opening session in the main room of the video conferencing tool. The two workshop organizers presented the main objectives of the WP within the ProMaaS project, introduced the workshop program and the underlying approach, and showed to participants the main functionalities of the collaborative whiteboard tool followed by a warmup exercise to get them ready to use the platform.

The subsequent workshop activities were conducted as smaller group sessions in the online breakout rooms. Participants were divided in three multidisciplinary groups of five to six participants, while workshop facilitators moved between breakout rooms to offer guidance during group discussion or answer to any question about the task. In the collaborative whiteboard, a dedicated space with predesigned task templates was available for each group. Apart from the main activity frames, filled with the sticky notes, matrices and charts to work with, each task template contained information about the goal of the activity,
the main instructions and a reference to the underpinning theoretical concept (Figure 2). In this way, the information about the task to be executed were always available to the participants.

In this way, the information about the task to be executed were always available to the participants.

In the first activity, each group was asked to go through the entire list of relevant factors previously generated with desk research and clustered per influencing area. A document containing a description of each factor was also attached to the whiteboard, to be consulted in case of hesitancy about factors meaning. Participants were then encouraged to discuss, confirm and eventually extend the list with other key factors in light of their knowledge and expertise about MaaS and its related issues.

The subsequent group activity (step 3 in Figure 1) consisted in examining the set of factors in terms of influence/sensitivity matrix. In this way each factor was categorized into active, critical, reactive or buffering, leading to the identification of its systemic role in the MaaS landscape.

The same set of relevant factors was then analyzed from a different perspective (step 4 in Figure 1), to assess the relevance of uncertain factors expected to have the greatest effect on MaaS development. Specifically, every group was asked to classify each factor with respect to the magnitude of its potential impact on the MaaS development and the level of uncertainty of its evolution. This led to the identification of the so-called critical or strategic uncertainties, defined as the key factors with a high impact and being uncertain.

The subsequent group activity (step 5 in Figure 1) was the development of axes of uncertainties, which form the basis for building future and focused scenarios. Participants discussed in group to collectively choose three of the previously identified critical uncertainties and define possible opposite outcomes for each of them. The outcomes represent mutually exclusive possible ways in which each critical uncertainty might unfold in the future. Moreover, participants were instructed to explore various interpretations and outcomes for each critical uncertainty, coming up with at least two or three axes of uncertainty for each critical factor. After having completed this task, groups were asked to choose one axis to put forward for each factor, by placing sticker dots on the axes they considered as the most meaningful and valuable.

Participants were then invited to join the plenary session to agree the scenario matrix (step 6 in Figure 1). Each group presented the outcome of their discussion on the chosen axes of uncertainty. After listening to each other interpretations and outcomes, participants were invited to vote on which two axes they deemed more plausible and interesting. Based on the participants’ votes and plenary discussion, a decision about
the final scenario matrix was taken. Before proceeding with the final steps, the two facilitators reviewed together the matrix to ensure it is credible, logical and meaningful for the project.

The final activity of the workshop consisted in the scenario development process (step 7 Figure1). For this activity, participants were divided in two breakout sessions. Each group was asked to develop two scenarios, by describing them in general terms from year 2030 perspective. For example, participants were encouraged to consider the implications and challenges of each scenarios from the perspective of the various stakeholders involved, such as local authorities, business, society. They were also invited to discuss some examples of policy and governance actions needed to steer the scenarios towards the overarching goal of ProMaaS, which is support the uprise of MaaS in European cities. A final plenary session gathering all the participants in the main virtual room closed the workshop, with a brief discussion of the main outcomes of the workshop and next steps.

Based on the material from the workshop, a more comprehensive description of the developed four scenarios have been developed, as presented in Section 6.
4. Relevant elements for the definition and analysis of MaaS governance models

4.1. Identification through literature review and desk research

As indicated in Section 4, the first step of the applied methodology consisted in the identification and definition of the external forces and internal variables considered as crucial for MaaS development and relevant for the definition and analysis of MaaS governance models. A description of the identified factors, clustered in nine influencing areas, is presented in this chapter.

4.2. Business framework

Generally, in relation to the urban context, the business framework concerns how cities create and deliver public value for citizens through service provision. More specifically, when looking at the business climate from the perspective of MaaS, some key issues and trends emerge, as listed in Table 1.

Table 1. Factors in the business framework area

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cities economic performance</td>
<td>It is closely linked to the concepts of competitiveness at the city level. It refers to the cities capacity to drive economic growth and jobs creation and increase productivity and citizens’ income through interventions on infrastructure, technology, innovation, regulations, etc.</td>
</tr>
<tr>
<td>Interest of private sector in MaaS</td>
<td>It is related to the wish of the private sector to get involved in a MaaS schema, either on the side of the infrastructure, system integration or operation. It also includes the consequent uncertainty and risk exposure (legal, financial, etc.).</td>
</tr>
<tr>
<td>Third-party ticket digital sale</td>
<td>It refers to the practice of making tickets from public and private transport providers available on third party platforms, for search, ordering and payment.</td>
</tr>
</tbody>
</table>
It depends on the willingness from transport providers to open up for a third-party digital ticket sale (Smith, Sochor and Sarasini, 2018).

Platform thinking

It is an innovative approach applicable to many sectors based on “the sharing of components, modules, and other assets” (Halman, Hofer and Van Vuuren, 2006, p. 149) across a family of products or service offerings to a broad set of users, contributors (e.g. third-party app developers) and complementary businesses. In this way, it implies a shift in business strategy towards ecosystem-based value creation. On a global scale, the transport and mobility sector is recently moving faster towards platform thinking.

Servitization

It is a phenomenon impacting many businesses around the world. It refers to the process of creating additional customer value by adding services to core products described as one of the drivers of MaaS, also boosted by digitization (Smith et al., 2019).

Policy and legislative framework

Changes in policies, regulations and laws and creation of new ones are pivotal for the development, functioning and diffusion of innovative technologies and services. Therefore, the key factors in this dimension refer to the policy, regulatory and legislative aspects that might affect MaaS development (Table 2).

Table 2. Factors in the policy and legislative framework dimension

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
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<tbody>
<tr>
<td>Local/regional boundary limitation</td>
<td>It refers to the service operational border. A MaaS offering might be available at local or cross border level. This factor is thus linked to the ability of MaaS subscribers to use the MaaS app and access the related services when travelling outside the geographical coverage area of their own. Different set of measures, requirements and rules might facilitate seamless mobility roaming (MaaS Alliance, 2017)</td>
</tr>
<tr>
<td>Collaborative innovation partnership</td>
<td>It is a collaborative approach to innovation in which different types of organizations share knowledge, best practices and other complementary resources for enabling the development of technologies, business models and services that will underpin the innovation (in this case MaaS). Governments and policy makers may promote collaborative approach to innovation in general, and to MaaS in particular, through policy- and regulation-based interventions (Smith et al., 2019)</td>
</tr>
</tbody>
</table>
## Public procurement process

Public procurement can be used by governments as a policy instrument to support the transition of urban mobility toward a smart and sustainable mobility systems, such as MaaS. Therefore, it can trigger the market diffusion of MaaS and MaaS-related services and technologies.

## Subsidies and public financial support for MaaS

It is about the public financial support for providing transport services offered within MaaS schemes with lower fares. This will depend on whether MaaS models align with the sustainability goals of governments, as public transport (UNECE Inland transport Committee, 2020). It also includes public support aimed at the facilitation of MaaS implementation and support the MaaS ecosystem (for example in relation to the design and implementation of the APIs).

## Data sharing and standardization

It is about the practice of sharing data of different organisations across various domains and sectors, and the critical process of bringing data into a common format. MaaS needs public and private mobility operators to share data to offer a convenient seamless solution to its customers. On the other hand, standards for data exchange between mobility services must be established. Governments could encourage the adoption of open data standards (Kao et al., 2020).

## Data privacy and security

It is about the proper collection, usage and storage of customers’ personal information and the processes and means to ensure the protection of digital data from unauthorized third-party access or unwanted actions. Considering that the sharing of personal travel information are essential for a demand-oriented provisions of MaaS services, regulations about cybersecurity and digital data protection have the potential to significantly impact MaaS implementation (Cottrill, 2019; Kao et al., 2020).

## Taxation

It covers the existing taxes and tax reliefs in relation to fossil-fuel, electricity, vehicle-registration, CO2, road use, expected to influence the long-term planning of MaaS implementation (Kao et al., 2020).

## Transparency and legal certainty

It represents the level of certainty regarding the legal foundations of agreements within privates or with public institutions. It requires a clear definition of responsibilities and risks.

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**Market and economy**
In the market and economy dimension, other crucial elements that may shape the effective deployment of MaaS have been identified. Specifically, factors related to entry barriers and competition in the MaaS market might have an influence on the creation and configuration of the MaaS ecosystem. Costs of the transport system arising through its usage, supply and infrastructure provision are also traditionally considered as relevant elements for transport market regulation, and subsequently they will be also relevant for MaaS market regulation. The factors included in this dimension are reported in Table 3.

Table 3. Relevant factors in the market and economy dimension

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market entry barrier</td>
<td>It is closely linked to factors such as data, infrastructures, and regulations that prevent or make it difficult for some operators to join the MaaS market. This might also have implications in terms of reduction of MaaS service offerings, thus diminishing service quality (Kao et al., 2020).</td>
</tr>
<tr>
<td>Market competition</td>
<td>It is related to the competition between mobility service providers, and between MaaS providers in particular (Kao et al., 2020). To realise the full potential of MaaS it is important to ensure a fair competition within the MaaS ecosystem, aimed at avoiding the occurrence of monopolistic situations in which the market is mainly driven by one single provider giving rise to anti-competitive behaviour (House of Commons Transport Committee, 2018).</td>
</tr>
<tr>
<td>Aggregated cost of driving (time, fuel, insurance, depreciation, etc)</td>
<td>It includes direct user costs of individual motorized mobility (e.g. cost of the vehicle, fuel/electricity, parking, road/mobility/congestion charges) and indirect costs (e.g. value of time, comfort, etc.). Also, it considers direct and indirect subsidies that affect user costs.</td>
</tr>
<tr>
<td>Cost of Public Transport</td>
<td>It includes capital investment, operations, and maintenance of infrastructure, rolling stock, and systems related. The variable is related to user costs in the form of subscriptions/fares but not directly linked since direct and indirect subsidies affect final pricing.</td>
</tr>
<tr>
<td>Cost of shared mobility</td>
<td>It includes the direct cost per passenger of shared mobility emerging schemas (e.g. subscription/fare/usage costs) and the indirect costs (e.g. the value of time, comfort, etc.). Also, it considers direct and indirect subsidies that affect final pricing.</td>
</tr>
</tbody>
</table>

System interfaces and externalities

Today’s urban mobility system is affected by some major challenges such as traffic jam and air pollution. On the other hand, new mobility solutions and technologies emerge with the aim to address those
challenges and enable the transition toward a smart and sustainable mobility system. Therefore, it is useful to understand the role and levels of uncertainty about the potential impact of MaaS on the urban system and its social acceptability. Table 4 lists and describes the relevant elements considered in this dimension.

Table 4. Relevant factors related to system interfaces and externalities

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>Social acceptability</strong></td>
<td>It is about the social acceptability of an application, technology, solution or measure for MaaS and sustainable mobility in general, which might determine its success. It refers to how system interfaces are received both by users and non-users, who might be in favour of against a given application, technology, measure or solution. It represent a major challenge for MaaS diffusion (Tomaino et al., 2020).</td>
</tr>
<tr>
<td><strong>Congestion</strong></td>
<td>It refers to congestion externalities that can be involved in the use of transportation infrastructures and mobility services offered by MaaS. Congestion problems are also considered as direct network externalities in multi-sided market, such as MaaS, in which the users’ utility of using the service is affected by the number of other users (Meurs and Timmermans, 2017).</td>
</tr>
<tr>
<td><strong>Local emissions</strong></td>
<td>It relates to one of the transport-related issues caused by mobility patterns and behaviours and covers pollutants emitted locally in cities by the various transportation modes. Expectations about MaaS impact on reducing pollution, through the reduction of ownership and usage of non-environmental friendly transport modes is one of the reasons for the policy makers interest in MaaS (Jang et al., 2020).</td>
</tr>
<tr>
<td><strong>Vehicle-Kilometre Travelled (VKT)</strong></td>
<td>It represents the sum of travelled kilometres by motorized vehicles in a given city or region and in a given period and it needs to be reduced or better managed to address environmental, social and economic externalities in the urban area. The impacts on VKT associated with MaaS is yet to be understood and might depends on various factors.</td>
</tr>
</tbody>
</table>

**Infrastructure, network and services**

An essential element to achieve a successful transition towards MaaS is the availability, quality and future developments of ICT and transport infrastructures, network and services. This represent, in fact, one of the dimension to assess a urban, metropolitan or regional area’s readiness for MaaS, affecting the likelihood for its success (Goulding and Kamargianni, 2018).
<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Back-end/ICT developments (5G/Blockchain)</strong></td>
<td>It refers to the internal support operations and the related ICT developments involved in the collection, processing, analysis, optimization, and output of information supporting user utilization of MaaS systems. Different concepts might be covered by this factor, such as big data, 5G, blockchain, which may bring many new possibilities for MaaS (de Wilde, 2019)</td>
</tr>
<tr>
<td><strong>Front-end interoperability and bundling</strong></td>
<td>It refers to the operations requiring a face-to-face digital interaction with the customer. Through a digital interface, which usually is a mobile application (Jittrapirom et al., 2017), different operations might take place, such as sales, marketing, information provision and customer support service. This means that the customers may use the app to purchase and use MaaS services and products, including individual offers for specific trips and mobility plans (i.e. bundles of services, offered with different pricing schemes) (Jittrapirom et al., 2017). It plays a central role in the development of MaaS business models, and may contribute to achieve a more sustainable transport system (Jang et al., 2020).</td>
</tr>
<tr>
<td><strong>Active mobility services</strong></td>
<td>It covers the supply side of active transportation, such as walking and cycling, including both the service offered (e.g. sharing or rental systems) and the required infrastructure (e.g. sidewalks, bike lines, parking facilities). It has a significant contribution to make for the transition towards sustainable mobility and MaaS, depending on the attractiveness of public spaces, the quality and availability of the services, and the prioritization over motorized transportation.</td>
</tr>
<tr>
<td><strong>Density and quality of public transport</strong></td>
<td>It covers the supply side of public transportation system, in terms of vehicles and required infrastructure. It is expected to act as the main backbone of MaaS transportation system (Caiati, Rasouli and Timmermans, 2020).</td>
</tr>
<tr>
<td><strong>Car/ride sharing services</strong></td>
<td>It covers the supply-side of shared motorized individual transportation, in terms of provider/service itself (Zipcar, ShareNow, Uber, Lift, etc.), and the required service-specific infrastructure (e.g. stations, parking facilities, charging points etc). It includes car-sharing schemas, car rentals, P2P solutions, ride sharing, shared taxi and any other option that enables temporary individual usage of a vehicle. The availability of these transportation modes represent a key element for MaaS</td>
</tr>
</tbody>
</table>
implementation (Jittrapirom et al., 2017; Ribas, Gallardo and Fernandez, 2020).

Society

Elements belonging to the social dimensions have also been addressed (Table 6). It encompasses some of the main issues and challenges the urban mobility system is currently facing and will continue to face in the near future due to socio-cultural changes and new approaches for citizens engagement in mobility planning.

Table 6. Relevant factors in the social dimension

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessibility and equity</td>
<td>It refers to the capability of each individual and household to always make the journey they need to participate in the economic, political and social life of the community. These are important elements. The design of MaaS needs to take into account those elements to prevent and overcome transport poverty and guarantee adequate accessibility to opportunities, services and social networks to all. Accessibility may depend on elements both on supply and demand side. For example, MaaS usage might be challenging for certain groups of people due to physical, economic, technological or infrastructural limitations (Kao et al., 2020).</td>
</tr>
<tr>
<td>Health and wellbeing</td>
<td>It refers to the way transport affects health and wellbeing, including positive and negative impacts. The transportation modes included in MaaS offerings may affect users’ physical health and subjective wellbeing, (for example through a modal shift from car-based mode to active modes), with possible consequences on a larger societal and environmental scale (Kao et al., 2020; Pangbourne et al., 2020).</td>
</tr>
<tr>
<td>Environmental and ethical awareness</td>
<td>They refer respectively to the process of understanding at the societal level (i) the fragility of the environmental system and the importance of its protection and (ii) the relevance of ethics in the development of technology and data sharing. These elements might be relevant for MaaS implementation, both in terms of</td>
</tr>
</tbody>
</table>
potential change of people mobility habits and dissemination of knowledge and good practices among service providers.

**Car dependency**

It refers to the high levels of individual motorized vehicle ownership and usage, characterizing modern society. It may be caused either by objective factors, when the automobile is the only suitable option, or subjective factors, when people are blind to other alternatives. It also includes the feeling associated to the driving experience (weather isolation, "freedom" perception, etc.), the experience out of the vehicle (living style, housing preferences, image values, etc.) and the habitual behaviour. Car dependency might be one of the major issue to be addressed for MaaS successful implementation (Pangbourne *et al.*, 2020).

**Information on MaaS**

It refers to the public awareness campaign to build and boost public recognition of MaaS concept and its impact, through media and an organized set of communication tactics. It may represent a driver for MaaS social acceptance.

**Participatory) planning capacity**

It refers to the ability of implementing a participatory process aimed at enabling active engagement and participation of civil society, placing citizens at the centre of decision making. It is a crucial element in citizen-centric mobility planning approaches. With the expansion of participatory approach in Sustainable Urban Mobility Planning, MaaS is expected to play a key role in this process (ERTICO – ITS Europe, 2019).

**Urban environment**

Several global trends are fundamentally changing how cities and urban communities are developing and how they will look like in the future, with subsequent effect on the urban mobility system. Table 7 summarizes the key elements in this dimension, related to long-term demographic forces, technological trends and urban planning trends.

**Table 7. Relevant factors related to the urban environment dimension**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population dynamics</td>
<td>It refers to the way in which the size and age structure of urban populations change over time. Increasing urbanization, urban sprawl and ageing population are widely recognized as long-term trends affecting urban mobility and the need for mobility innovations in urban area.</td>
</tr>
</tbody>
</table>
Data dependency

It is about the increasing reliance of cities on digital technology for a wide variety of functions, also related to the transport and mobility systems (such as monitoring, information provision, sensing, etc.). It encourages innovation and creates efficiencies, but on the other hand can make cities and city infrastructure vulnerable to malicious hacking.

Consumption of spaces for transport purposes

It includes urban spaces used for all the transport and mobility associated infrastructures (streets, lanes, tracks, etc.) and activities (parking, charging, etc.). The reduction in automobile usage implies a gain of space no longer needed for car parking, and can be used for parks or other urban amenities, while less traffic congestion may have positive effects on environmental sustainability, public health and road safety with an overall improvement of citizens’ quality of life (Caiati, Rasouli and Timmermans, 2020).

Quality of public spaces

It is about the attractiveness and value of urban open spaces for social and public activities. Urban mobility can contribute to the creation of more attractive public spaces, thus resulting in more liveable cities. Contemporary trends that are placing citizens’ at the centre of urban systems by creating better public spaces and encouraging soft mobility initiatives are increasing in popularity all over the words (Ravazzoli and Torricelli, 2017).

Citizens’ behaviors and lifestyle

One of the crucial elements for MaaS implementation is the behaviors and lifestyle of citizens. Their changes and shift in habits, preferences, attitudes, values and lifestyle shaping their choices about the way they work, use services and move around the city are some of the aspects covered in this dimension (Table 8)

Table 8. Relevant factors related to citizens’ behaviour and lifestyle

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible working</td>
<td>It is a rapid evolving trend for the future of work, expected to influence also the urban context, the transport infrastructure and individual travel patterns. It mainly refers to the practice of giving more freedom to workers to choose when, where and why fulfil their roles.</td>
</tr>
<tr>
<td>Use of active mobility options</td>
<td>It is about active mobility behaviour, including walking and cycling. MaaS is expected to promote active mobility. On the other hand, citizens’ willingness to adopt MaaS might depend on their active mobility.</td>
</tr>
</tbody>
</table>
### MaaS adoption by citizens

It is about people deciding to, and starting to, use MaaS services. It is based on an information-processing activity and it strongly associated with the decision maker (i.e. citizen) socio-demographic and travel related characteristics and attitude toward this new concept (Sochor, Karlsson and Strömberg, 2016; Caiati et al., 2017).

### Customization and personalization

It refers to people preference for personalized and right-sized services and products to fit their preferences, personalities and lifestyles. It is a key characteristic of MaaS (Jittrapirom et al., 2017).

### Public Transport ridership

It is about public transport usage. MaaS is expected to foster the usage of public transport, by combining it with other mobility solutions. On the other hand, citizens’ willingness to adopt MaaS might depend on their current usage of public transport (Matyas and Kamargianni, 2017; Caiati, Rasouli and Timmermans, 2020).

### Multimodality

It is about citizens’ relying on multiple transportations modes for all travel motives, if multiple alternatives are available. MaaS is expected to encourage multimodal travel behaviour, by offering mobility bundles. On the other hand, citizens’ willingness to adopt MaaS and use MaaS bundles might depend on their current multimodal travel patterns (Jang et al., 2020).

### Generational gap

It refers to the difference in thoughts, lifestyle, values, preferences and opinions among people of different age groups. For example, the current younger generations are characterized by less car oriented mobility patterns (Circella et al., 2016). Young people are also supposed to be the early adopters of new technologies and innovative services (Caiati et al., 2020).

### Shift away from traditional ownership

It refers to people spending patterns change under the influence of various trends such as the sharing economy and collaborative consumption. These concepts aim at providing consumers with access to a particular product over ownership of the product.

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**Global threats**

There also a number of external forces represented by potential global catastrophic risks that may have an influence on the demand and supply of transport in general, and MaaS in particular. These are presented in Table 9.
Table 9. Relevant factors about global threats

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Climate and climate-related hazards</strong></td>
<td>It is about potentially hazardous atmospheric phenomena that can negatively impact human settlements and the environment. It is widely recognized as one of the main concerns for cities all over the world, and it is likely to damage and deteriorate the transport infrastructure. On the other hand, cities and the transport sector represent the major responsible for climate change.</td>
</tr>
<tr>
<td><strong>Infectious disease/pandemics</strong></td>
<td>It is about large-scale outbreaks of infectious disease that spread over a wide geographic area, causing significant economic, social, and political disruption. From the transport perspective, it implies significant changes in transport mode usage and individual travel patterns, due to the rising level of risk caused by social contacts. Nowadays, the Covid-19 outbreak is seriously impacting the mobility system and its posing multiple challenges to the future of MaaS development (Hensher, 2020).</td>
</tr>
<tr>
<td><strong>Cybersecurity threat</strong></td>
<td>It refers to the risk of malicious acts that can damage and steal data or disrupt digital life. Considering that the digital platform and digital data represent an important component of MaaS, it would seriously affect MaaS development, fostering distrust in MaaS system.</td>
</tr>
</tbody>
</table>

### 4.3. Validation through workshop group activity

The full set of identified factors were presented to workshop participants (Figure 3), during the first group activity (see Step 2, Section 3). Therefore, they were validated after interactive discussion on the meaning of each factor and on its potential connection and relevance with the MaaS landscape. Moreover, other factors not covered by the proposed ones were identified through group discussion. These are listed in Table 10, and add to the others previously identified as main input for subsequent workshop activities.
Figure 3. Scenario factors as presented in the Miro Platform for the validation exercise.

Table 10. Additional factors across multiple dimensions as proposed by participants during workshop activity (Step 2)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>Validated and convincing business models</td>
</tr>
<tr>
<td></td>
<td>Public transport pricing</td>
</tr>
<tr>
<td>Category</td>
<td>Keywords</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Marketing of public transport ticket</td>
<td></td>
</tr>
<tr>
<td>Public sector incentives</td>
<td></td>
</tr>
<tr>
<td>Interoperability of different operators/companies</td>
<td></td>
</tr>
<tr>
<td>Relationship between public transport concessions and their willingness to share concession space</td>
<td></td>
</tr>
<tr>
<td>Policy and legislative framework</td>
<td>Law supporting circular economy</td>
</tr>
<tr>
<td></td>
<td>Regulation to avoid private monopoly</td>
</tr>
<tr>
<td></td>
<td>Platform strategy</td>
</tr>
<tr>
<td>Economy</td>
<td>Verticalization creating oligopolies</td>
</tr>
<tr>
<td></td>
<td>System mechanism to create a fair playing field for all operators</td>
</tr>
<tr>
<td>System interfaces/externalities</td>
<td>Change of political agenda</td>
</tr>
<tr>
<td></td>
<td>Acceptance of foreign companies</td>
</tr>
<tr>
<td>Social</td>
<td>Road safety</td>
</tr>
<tr>
<td></td>
<td>Digital divide</td>
</tr>
<tr>
<td></td>
<td>Economical and physical inclusivity</td>
</tr>
<tr>
<td>Urban</td>
<td>Urban air mobility</td>
</tr>
<tr>
<td></td>
<td>City logistics</td>
</tr>
<tr>
<td>Behaviour and lifestyle</td>
<td>Digitalization</td>
</tr>
<tr>
<td></td>
<td>Private ownership</td>
</tr>
<tr>
<td></td>
<td>Misaligned lifestyles and mobility potential</td>
</tr>
<tr>
<td></td>
<td>Worker benefits</td>
</tr>
<tr>
<td>Global threats</td>
<td>Economic crisis</td>
</tr>
</tbody>
</table>
5. Systemic analysis of the governance models

A workshop involving the ProMaaS partners, and the deliverables from the other Work Packages (WP) are the main source of information to understand the system where MaaS is embedded on. Previous projects dealing with the same topic enabled to start the analysis from a more advanced stage.

5.1. Systemic roles of the MaaS elements

This section discusses the results of a systemic analysis, focused on the regulatory components of the system, which is the focus of the project.

Workshop inputs

For the systemic analysis, the participants in the workshop were divided in three groups working independently. Given a set of elements identified beforehand (from the inputs described at the beginning of this section), each group were asked to define the Influence and Sensitivity of each element in a scattered diagram as follows:

- Define the value in the horizontal axis in function of its sensitivity to other factors of the MaaS environment
- Define the value in the vertical axis in function of its influence over other factors of the MaaS environment.

The participants were asked to discuss with the other members of the table and try to find an agreement. Specifically, they were asked not to not build averages of the different opinions.

The location of each variable in the diagram reveals its systemic role. Depending on where the element lays in the diagram, it can be classified as:

- Buffering, if they are rather inert for the system,
- Reactive, if they react to the system, but have very little influence over it (e.g. indicators),
- Active, if they have strong effect over the system, and do not react to the other variables (e.g. effective levers),
- Critical, if they are both active and reactive,
- Or neutral
The figure below contains an illustration of these areas in the diagram.

Figure 4. Diagram for the identification of systemic roles.

Of particular importance for ProMaaS are the variables in the active and critical sectors of the diagram. These are the ones that administrations and stakeholders have to focus on in order to successfully deploy MaaS schemas in European contexts.

This report focuses on the governance, regulatory, and legal elements of the system, although a complete spectrum of the elements were considered for the discussion. The figures in the following pages present the result of the discussions for the different groups. The soft yellow color of the “sticky notes” in the figures of the following pages denotes the more interesting elements for ProMaaS.

A pattern emerges from the analysis, and that is that none of the regulatory elements has been identified in neutral or reactive roles, which provides some validation to the exercise. Only a couple of regulatory elements were placed by one group in the buffering area, but this was contested by the other two.
Figure 5. Results of the systemic analysis for Group 1.

Figure 6. Results of the system analysis for Group 2.
The following section discusses the results of the workshop.

5.2. Regulatory elements with a relevant role in the MaaS system

The following are the regulatory elements identified by the MaaS consortium as relevant for the implementation. These have been organized from the most critical to the those almost optional.

Critical elements

- Limitations of the legal framework regarding territorial boundaries.
- Framework for data privacy and security.

Priority elements

- Market regulation, particularly related to the avoidance of monopolies and lowering the entry barriers for new competitors.
- Stability of the legal framework, and transparency.
- Public financial support, mainly during the uptake stage.
Supplementary elements

- Taxation on private motorized modes.
- Ownership model of the MaaS operator.
6. Future scenarios

6.1. Workshop Inputs

In the present section, a discussion of the inputs and the main outputs of the workshop activities performed from step 4 to step 7 of the described methodology (Section 3) will be provided.

As extensively described in Section 4, there are several elements expected to influence MaaS future development. However, understanding how these elements will evolve in the long term and what this will imply for MaaS development is extremely challenging, given its high level on uncertainty. This means that there is a need to apply appropriate techniques to account for the high level of uncertainty about all the aspects of the investigated problem. This also entails a raise in awareness in decision makers about the level of uncertainty surrounding the real-world policy situation, which is essential for the development of long-term policy and governance interventions.

Appropriate methodological approaches come from the transport future research field. According to the level of uncertainty and the short or long term nature of the problem, different techniques can be used for transport policy analysis (Walker et al., 2003). Scenario planning is one of these techniques. It does not aim to predict what will happen in the future. The main goal is, in fact, to explore what can possibly happen and navigate uncertainty. It is on this concept that the definition of scenario is based on. The (UNEP, 2002) defines scenarios as “descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will play out and what new factors will come into play [...] They paint pictures of possible futures and explore the differing outcomes that might result if basic assumptions are changed” (UNEP, 2002, p. 320). Scenarios can be built in different ways. It is possible to distinguish between qualitative scenarios, based on narratives, and quantitative scenarios, based on numbers. Also, different techniques may be used to generate and collect ideas, knowledge and views about plausible future scenarios. Examples of these techniques are surveys, panels, and workshops (Börjeson et al., 2006).

In this project activity, we followed an explorative approach to scenario building, based on narratives and developed through a scenario workshop. The main question we want to answer was: “What can happen?”, in order to think in terms of several possible futures for MaaS development, and then use these scenarios to explore how to adapt to several different types of outcomes (Börjeson et al., 2006). In fact the main goal was to explicitly examine the implication of a range of plausible futures on MaaS governance models, and understanding, for example, how these will impact the role of public and private actors in enabling and governing the development of MaaS, and what can be the possible implications on the social, environmental and economic dimension. Specifically, the scenarios axes technique has been used. It represents a systematic approach to scenario development, in which scenarios are developed from the combination of a specific set of relevant factors, defined as critical uncertainties (van ’t Klooster and van Asselt, 2006). According to this technique, the two factors identified as the ones that have the highest uncertainty and the highest impact on MaaS development, represent the scenario dimensions (as vertical
and horizontal axes) that form the four quadrants to frame the scenarios. In fact, each quadrant of the so-called scenario matrix represents an internally consistent possible future. Lastly, scenario descriptions are created, as a basis to understand the possible consequences on MaaS future developments from various perspectives. As described in Section 3, all the steps required for the generation of the scenario matrix (i.e. discussion on the scenario factors, identification of the critical uncertainties and certain developments, development of the axes of uncertainty, scenario building and scenario description) have been developed in a participatory manner during the workshop. The results of the various steps are described in the following sections.

### 6.2. Identification of critical uncertainties and certain developments

In the fourth step of the applied methodology, workshop’s participants worked in groups to examine and classify the previously discussed factors in terms of their potential impact on MaaS development and the uncertainty of their future state. The factors placed in the top-right quadrant (Figure 8), and thus categorized as having a high impact and a high uncertainty, are the critical uncertainties, which need to be considered for scenario building. On the other hand, factors with a high impact and low uncertainty are defined as certain developments. The other factors in the remaining quadrants are considered as secondary elements that can be ignored during the scenario building process.

![Figure 8. Identification of critical uncertainties in the impact vs uncertainty matrix (Source: van ’t Klooster and van Asselt, 2006)](image)

From the results of the group activity (portrayed in Figures 9, 10, 11), it is interesting to note that none of the factors in the “global threats” dimensions was positioned in the “high impact - low uncertainty” quadrant. On the contrary, the results underlined a common view among the three groups about the future roles of public transport and services such as car sharing and ride sharing on MaaS development, since they all classified these two factors as both material and reasonably predictable.

Moreover, according to the results, most of the factors belonging to the policy and legal framework, to the business framework and to the market and economy have a high impact on MaaS development and are
also highly unpredictable. In particular, the factor named “subsidies and financial support to MaaS” was positioned in the “high impact - high uncertain” quadrant by all the three groups. Also, some of the factors related to citizens’ behaviour and lifestyles and others from the “global threats” and “infrastructure, network and services” dimensions were classified as critical uncertainties, although this pattern was not common to all the three groups.

Considering the high numbers of factors in the top right quadrant, and the variance in groups’ outcomes, each group was asked to agree on the identification of at least three priority factors considered as the most important for MaaS development, by placing voting dots on the stickers within the “high impact – high uncertainty” quadrant of their own matrix (as shown in Figure 9, Figure 10, and Figure 11). In this way, it was possible to come up with a reduced number of most influential and unpredictable driving factors. In fact, the three stickers with the highest number of dots in each group were then used for the development of the axes of uncertainty. To manage any overlaps in the identification of critical uncertainties among the three groups and ensure a plurality of interpretations, the facilitators checked with each group what critical uncertainties they were choosing and which perspective they were developing to determine the opposites outcomes of each critical uncertainty.

Figure 9. Results of Impact vs Uncertainty matrix from Group 1. The coloured voting dots represent participants expressed preferences for the priority factors. Different colours have been assigned to each participant.
Figure 10. Results of impact vs Uncertainty matrix from Group 2. The coloured voting dots represent participants expressed preferences for the priority factors. Different colours have been assigned to each participant.
Figure 11. Results of impact vs Uncertainty matrix from Group 3. The coloured voting dots represent participants expressed preferences for the priority factors. Different colours have been assigned to each participant.

The outcome of this activity is the following list of critical uncertainties:

- Self-driving vehicles
- MaaS adoption by citizens (chosen by two groups)
- Local/regional regulatory, political and digital boundaries
- Subsidies and public financial support for MaaS
- Third-party digital ticket sale
- Market competition
- Policy and public financing framework
- Interest of private sector in MaaS

### 6.3. Development of the axes of uncertainty

Based on the results of the previous step, each group worked on the definition of the axes of uncertainty, necessary for the subsequent development of the scenario matrix. The definition of the axes of uncertainty consisted in brainstorming and identifying alternative ways a critical uncertainty might play out. Therefore, each critical uncertainty was described using opposite states under multiple interpretations of the axis of uncertainty, resulting in two to three axes for each critical uncertainty.
The results of this activity are shown in Figures 12, Figure 13, Figure 14. As an example of different interpretations of the axes of uncertainty, group discussion on “Self-driving vehicles” led the group to come up with different opposite outcomes on the basis of various perspectives, namely the technology (partial automation vs fully automation), politics economy (successful and full uptake of autonomous vehicles in MaaS systems vs autonomous vehicles as part of private mobility) and the legal or ethical framework related to insurances (individual responsibility vs corporate responsibility). The same approach was used across all the identified critical uncertainties. This resulted in a long list of axes (a total of 24) that could potentially represent the basis for the scenario building process. In fact, the scenario matrix can be generated by selecting two key uncertainties with two opposite states, which would then act as the x and y axes, respectively. Furthermore, as it is possible to see in Figure 8 and Figure 10, “MaaS adoption by citizens” have been chosen as critical uncertainty by two groups. However, it has been developed under different perspectives, and consequently under different opposite outcomes, not resulting as overlapping axes. In fact, while the Group 1 considered the context of adoption (urban vs rural; individual vs corporate responsibility; citizens low purchasing power vs citizens high purchasing power), Group 3 mainly referred to citizens transport-related characteristics (i.e. citizens’ interaction with service, private car ownership and multimodal behaviour).

*Figure 12. Axes of uncertainty developed by Group 1 in Miro. The coloured voting dots represent participants expressed preferences for the axes to put forward in the plenary session.*
Figure 13. Axes of uncertainty developed by Group 2 in Miro. The coloured voting dots represent participants expressed preferences for the axes to put forward in the plenary session.
In a participatory approach to scenario building, the selection of the two axes should be made by reaching consensus among participants, which need to examine the full list of developed axes. It is easy to imagine that such an approach would require a huge amount of time and could potentially make difficult the convergence of participants’ opinions on a very limited number of axes. Therefore, a short list of axes of uncertainty was created by letting each group decide on one axis to put forward for each critical uncertainty. A certain number of voting dots was given to each participants, so that they could place them on the axes they found more relevant for future MaaS scenarios, as it is possible to visualize in Figures Figure 12Figure 13Figure 14. By tallying the number of votes for each axis, it was possible to determine which ones were favoured by the group. This resulted in a total of three axes of uncertainty for each group, see Table 11.

Table 11. Short list of critical uncertainties with their opposites outcomes, as derived by step 5 of the methodological approach (Section 3).

<table>
<thead>
<tr>
<th>Critical Uncertainty</th>
<th>Outcome A</th>
<th>Outcome B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-driving vehicles</td>
<td>Mix of self-driving and human drivers</td>
<td>Fully automated</td>
</tr>
</tbody>
</table>
### Means of MaaS adoption

<table>
<thead>
<tr>
<th>Means of MaaS adoption</th>
<th>Individual responsibility.</th>
<th>Corporate responsibility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local/regional regulatory, political and digital boundaries</td>
<td>Unstable.</td>
<td>Stable long-term agreement.</td>
</tr>
<tr>
<td>Subsidies and public financial support for MaaS</td>
<td>Only public transport will receive subsidies/financial support.</td>
<td>All publicly accessible transport modes can receive subsidies/financial support.</td>
</tr>
<tr>
<td>Access to data</td>
<td>Only the party offering the service has client data.</td>
<td>All the parties involved receive client data.</td>
</tr>
<tr>
<td>Market competition</td>
<td>Monopoly (one platform player takes all).</td>
<td>Perfect competition (lots of suppliers).</td>
</tr>
<tr>
<td>Policy and public financing framework</td>
<td>APIs are not available.</td>
<td>APIs are open, public, standardized, and accessible.</td>
</tr>
<tr>
<td>Maas adoption by citizens, depending on private car ownership</td>
<td>Private vehicle ownership rate is constant.</td>
<td>Services are viable alternatives to ownership.</td>
</tr>
<tr>
<td>Interest of private sector in MaaS</td>
<td>Mobility providers don’t want to cooperate and provide individual services.</td>
<td>Mobility providers embrace the MaaS concept.</td>
</tr>
</tbody>
</table>

### 6.4. Scenario building

The outcome of the group activity on the development of axes of uncertainty was presented in a plenary session. The main goal of the plenary session was to reduce the resulting set of axes (as shown in Table 11) in two to three axes, to create possible alternatives scenario matrices meaningful for MaaS future development. This represented a crucial step of the scenario development process, which required reaching consensus across workshop participants, as previously explained. For speeding up consent achievement about scenario axes in the entire group of participants, each group was invited to present to the others their three axes of uncertainty, by describing the critical uncertainties, the two opposites outlooks and the rationale behind their decision. In this way, it was possible to ensure that each participant developed a more comprehensive understanding of the entire list of axes, before expressing her/his preferences for only two of them that they thought to be more meaningful for the project. This facilitated a shared decision on a couple of alternative combination of scenario dimensions, to explore how the scenarios matrix could look like and finally agree on one scenario matrix.
The scenario axes that resulted to be most preferred by workshop participants were selected as the basis for constructing the scenarios and examine four possible future states. Specifically, the first axis examines the policy and public financing framework in terms of APIs, and therefore as lack of APIs availability (e.g. non-existent standards, non-standardised information and lack of parties’ consensus on data formats) versus existence of open, public, standardized and accessible APIs. The second axis examines market competition in terms of monopoly condition versus perfect competition.

Before finalizing the decision on scenario matrix, a couple of alternatives matrices were also explored. For example, one workshop participant proposes a different combination of critical uncertainties, by considering also an uncertainty related to the user perspective. Specifically, we looked at the matrix resulting from the combination of the following two axes: the first axis examines the policy and public
financing framework in terms of APIs, as previously described; the second axis examines the user perspective in terms of car ownership as still prevalent versus MaaS services considered as a valuable alternative to car ownership. After a brief discussion, the facilitators and the participants agreed on the matrix proposed as first (Figure 16), which was also assessed in terms of plausibility, consistency and distinctness. Furthermore, the others critical uncertainties and factors considered to have an impact on MaaS developed, were not ignored; rather they were used to research and develop detailed and coherent scenarios description.

![Figure 16. Scenario matrix, as developed in Miro.](image)

### 6.5. Scenario description

After the plenary session, the participants were again divided in two groups to work on scenario description from year 2030 perspective and on the related governance actions needed to steer the scenarios toward the objective of the project, which is to support the uprise of MaaS in European cities. Therefore, each of the two groups were linked to two scenario quadrants. To describe the scenarios, participants were asked to also incorporate in the scenario plots the others key factors assessed as pivotal and significant for MaaS development in the previous steps. They were also invited to think how key actors, such as governments, industries and citizens, might behave under the described scenario quadrant.
Based on the outcomes of this final workshop group activity, we developed the following four scenarios, which will provide the starting ground for discussion:

1. Mobility Walled Garden: In this scenario, data sharing, data ownership, data standards and data integrations are less supported by the public finance and policy framework. In addition, the MaaS market is mainly dominated by few big players with a monopoly and oligopoly power.

2. Open Data Power in Standby: In this scenario, the public finance and policy framework is favourable to and stimulate a truly open transport data and data standard ecosystem, while the MaaS market is mainly dominated by few big players with a monopoly and oligopoly power.

3. Everyone on their own: In this scenario, data sharing, data ownership, data standards and data integrations are less supported by the public finance and policy framework, while the MaaS market is characterized by effective competition, in which multiple large and small actors compete with each other on an equal and fair footing.

4. Open mobility ecosystem: In this scenario, the public finance and policy framework is favourable to and stimulate a truly open transport data and data standard ecosystem. In addition, the MaaS market is characterized by effective competition, in which multiple large and small actors compete with each other on an equal and fair footing.

A more detailed description of the four scenarios, written from a 2030 perspective, is provided in the following sections, together with a list of policy and governance actions identified with workshop participants.

**Scenario 1: Mobility Walled Garden**

The 2018 EU GDPR to protect citizens’ data and other tentative to steer its own course on technology regulation did not bring the expected results. With the rise of online platforms and the diffusion of innovative technologies, such as Internet of Things and machine learning systems, there was a remarkable intensification of data collection practices in all the sphere of citizens’ life. Moreover, the last decade have been marked by a remarkable increase in cyberthreats. The rapidly increasing body of data generated by all the transport vehicles available in the cities (i.e. through both the usage of mobile applications, the integration of sensors for real-time tracking and the roll-out of self-driving cars) have driven cyber-criminals to target app-based mobility services, threatening both travellers and operators.

The strong enthusiasm around open data and open APIs that has characterized the previous decades has now dropped significantly. Open APIs represented, in fact, one of the most commons source of data breaches, exposing customers to security risks, such as data leaks, data fraud, abuse of data and illicit transactions. Within this context, most governments stopped to invest in a policy and legal framework supporting open data and open and standardized APIs. They realized that the free access to platforms data by everyone lead to a counter-effective results for the protection of citizens’ right to privacy, making them more vulnerable than ever. Overcoming these risks requires significant costs to put in place the correct policies, procedures and infrastructures for safe handling, storage and processing of data. So, this is a key consideration to take into account, especially for countries and cities with budgetary constraints. It also risks holding back the next waves of innovation in the smart mobility field. The emergence of new players as third-party MaaS providers and the MaaS market itself is braked by the closure of data and APIs. It has become difficult to offer travellers access to a full range of mobility options.
Meanwhile, big digital corporations have taken over the economy creating a monopolistic platform ecosystem. They provide multiple services to citizens, creating their own walled garden to keep users locked in. The walled garden strategy is also applied in the urban mobility sector. Connective platforms dominating the market offer travellers integrated advice for planning, booking and pay for any urban trip, incorporating also transit ticketing. They also provide their own exclusive mobility services, through the acquisitions of or the creation of partnerships with public and private transport operators. This means that they strategically lock certain mobility service inside or outside their platform, resulting in a smaller diversification of mobility options and in a service not available on larger scales. This might, sometimes, translates in a worse customers’ experience, since they will not surely be offered with the most cost-effective or sustainable option, thus risking to not place citizens and their needs at the core of the system.

Unlike public authorities, corporate owners have, in fact, less interest for societal goals, and are more driven by increase profit and market share. This also has some implications on public transport, both in terms of ticket revenues and user base. Lastly, considering that they own and collect a huge amount of transport data and citizens travel behaviours’ data they might have a great influence on government decision’ making.

Actions

- Develop data commons: data is owned by users and shared for the benefits of the society.
- Policy to boost collaborative innovations partnerships.
- Market watchdog which doesn’t allow anti-competitive behavior.
- Regulations for fair MaaS playing fields for all parties.
- Tickets regulated to be sold without profit.
- Independent body for data protection and standardization.
- Provide permits for operation within MaaS ecosystem.
- Support blockchain development, to open up MaaS also to small players.

Scenario 2: Open Data Power in Standby

The high ambitions of the European Commission to make Europe climate neutral in 2050, as stated in the Green Deal signed in 2019, started showing signs of success also in the transportation sector. The implementation of public and integrated policies encouraging the shift towards sustainable and multimodal transport and mobility digitalization has led to increasing interest on MaaS, which now represents a well-established concept. Considering its high reliance on data and data standards, MaaS also acted as a leading force in the open data movement in the transport field. Therefore, the implementation of data standards and open data infrastructures represents an essential component of the public policy toolbox and a methodological element in the transport policy domain, along with other policy domains.

Governments and public authorities at different levels (i.e. local, regional, national, European) deeply recognize the role of public, standardized, open and accessible data as a source for innovative transport technologies across Europe. They foster innovation in the urban mobility ecosystem by steering public and private transport operators and organizations to pursue standardized data structure, open data strategies, and open ticketing API, through the provision of technical and standardization specifications for data publishing and a regulatory and legal framework. The Intelligent Transport System (ITS) Directive of the
European Union of 2010 was a pioneer among the other regulations aimed at supporting public accessibility of data in Europe. Furthermore, many governments such as the Netherlands and Finland already invested in the previous decade on the development and test of API specifications and implemented regulations to require traffic providers to open up their interfaces to others to create the conditions for MaaS development.

Considering that making data public accessibly and open ticketing API is now an essential requirement, every public and private mobility player publish their data in a common standardized format and allow third parties to sell their tickets, thus generating a large availability of open transport data (including fare data) and shaping an effective level playing field for MaaS. From the MaaS end-user perspective, this implies that customers are able to access to a wide variety of fare schemes and to a seamless travel experience, thanks to the integration of multiple modes and to cities investments in multimodal infrastructures.

However, there is still a main obstacle to the unlock of the full potential of open data and standardization of data and interfaces. This is represented by the current market structure that has progressively prevailed over the past years. Public actors and emerging mobility aggregator companies intended to take the lead in MaaS developed leveraging the availability of open data and data standards, but they were slow compared to the most efficient MaaS platforms providers who now take the position of quasi-monopoly. As big and established players, digital giant companies managed to gradually expand their power in the urban mobility arena, thanks not only to their technical and financial resources, but also to their existing huge proprietary database and a massive volume of users on a large scale. They already collected and used data on frequency and timetable of public transport, real time data on shared-modes location and availability, and accurate information on travel time. Through the real-time tracking of their customers, they also possess data from the traveler itself, regarding its mode choice, route choice, GPS-inferred locations, preferences, behaviors etc., which represent a by-product and a relevant source of information for transportation and urban transport policy. They also sell transport tickets, choose the mobility providers and possess their own mobility services. In this way, they developed more consistent, personalized and customized mobility services, easily reaching the critical mass, which is a success factor in the economics of digital platforms. Considering that a consistent part of their revenues comes from the monetization of the key information on actual customers preferences and behaviors gathered through their platforms, they may sell tickets or subscriptions at a price below of those of transport providers, giving rise to price wars.

Citizens with their rights and their needs continue to be at the center of data privacy and urban mobility conversation, and ensuring data privacy, transparency and security is essential to achieve citizens’ and customers’ trust. In addition, an increased awareness in ethical, environmental and social issues has fueled the diffusion of a self-regulating business models that helped companies to be socially responsible and conscious of its impact on the different aspects of the society, including the economic, the environmental and the social sphere. Within this context, the current MaaS quasi-monopolistic model goes beyond the standard corporate model in which commercial interests are the priority. In fact, they are actively committed in harnessing the power of data and technology to help cities and countries in the transition toward a sustainable and smart mobility, by cooperating and collaborating with governments, public transport authorities and young firms.

Actions
- Keep APIs open and standardized and data freely available, since it is essential for MaaS success and also favor small businesses and start-ups.
• Governments regulation of price fixing. Governments determine the price.
• Governments programs to facilitate collaborations among players
• KPI’s applicable to all players
• Watchdog to allow or prevent quasi-monopoly.

Scenario 3: Everyone on their own

Under this scenario, the MaaS market is healthy. The incentives to bring more players to the market are successful, and the private sector reacts by bringing innovation, new and more services. There is a downside though: no one is willing to cooperate with each other. Providers jealously take care of their customer base and alliances.

Under this perspective the user is completely at the center, which leads to satisfied customers and an actual trend towards multimodality and the rise of active mobility as a serious alternative to motorized individual transport, for some privileged groups, and for a while.

The situation leads to a niche approach, with very differentiated groups of users and matching services. Customer bases are small, and while each player is trying to outsmart the competition and expand their market, it is likely that along the way many will abandon the race leading to a monopolistic situation, and to even larger gaps in the coverage of the services.

Under this scenario, MaaS provider will specialize in one type of service, with limited available transportation modes, and giving Public Transport operators a hard time trying to integrate into their systems. On the other hand, there will be a thriving landscape for small transportation suppliers, but with exclusivity clauses, small markets to serve and high operative costs it is an unstable situation.

The fierce competition means a race to the bottom for pricing strategies. This added to the high costs associated to small customer bases and specialized and unique services casts a rather dark future for most of the MaaS players.

Users will end up with many platforms to solve their mobility needs, and public spaces crowded with the vehicles of the many providers. The promise of low prices for moving around makes the less-than-optimal situation somehow acceptable.

On the long run, the situation will stagnate. The surviving and then powerful player will block any competitor to enter the market, there will be few incentives to cover the profitable customer base they have chosen. Others failed already. Even the quality of the service might start suffering in absence of the once motivating competition.

There is room to improve the situation. But actions have to be taken swiftly while there are still many providers in the market.

Actions
• The public administration might have to invest on an open API, tied to nationwide/citywide ICTs and data standards.
• Improve and facilitate dialogue among private actors.
• Create voluntary programs to motivate the adherence to the common API and standards.
• Provide incentives for platforms using the common standard.
• As a last resource, the administration might force MaaS providers to open their APIs as part of the permitting process.
• To broaden the market, the administration can provide incentives to cover parts of the city or users less profitable.
• If there is a strong public transport operator (e.g., Transport for London), it should deliver its own open platform, and pull MaaS providers to its ecosystem.
• Cities might implement a cap on the number of providers and limit the use of space.

Scenario 4: Open Ecosystem

Under this scenario there is not much to say. Stars have aligned: there is a healthy market with a fair number of providers covering everyone and every place in the city. They operate under the same standard or have opened their own standards to the competition. For the user, it makes no difference to use one platform or the other. They can have access to all existing modes and fleets even if they do not belong to the MaaS provider they have chosen.

The local public transport is in each case part of the offer, and users have real options to become multimodal and leave their cars at home. The dream of one-stop-shop for mobility has become a reality. Under this scenario the user gets the best possible price, and the best possible service. It is not the race-to-the-bottom situation of the scenario 3 (maximum service to the lowest possible price), but the success of the platforms depends on the balance of the value proposition and the price to the customer.

The customer base is large and stable. Probably the number of providers is not large, but it is definitely far from a monopolistic situation. The regulation is in place to ensure that competition is fair and there is always the possibility for others entering the market.

This scenario is sure not by chance. It is likely that the regulations to foster a healthy market are in place, there are regulations and standards that make possible the integration of ICTs and data interoperability, and there are balanced charges and incentives to cover the city with the service. If all the regulation is already there what actions are still missing?

Actions
• First and foremost, keep the good done work so far!
• There is an opportunity to stop subsidizing public transport and target better the recipients of funding by subsidizing trips.
• MaaS platforms can open their APIs to include ride-hailing and private micro-providers.
• These platforms can start involving other elements of mobility, such as parking management, congestion charging, etc.
• It is the moment to target strategic targets beyond the feasibility of MaaS. Objections on the areas of mobility behavior, traffic outcomes, environmental impacts and others have to steer the direction of MaaS forward on.
• It is the optimum scenario to target car ownership.
7. Conclusions

The aim of this deliverable was to explore the main challenges that need be addressed for a successful implementation of MaaS and identify plausible future scenarios of MaaS in Europe, taking into account a variety of factors related not only the regulatory, policy and governance framework, but also to the business models of mobility providers, citizens’ characteristics and lifestyle, technologies available, built environment, and so on. To this end, a systematic analysis and a scenario analysis were conducted, based on the outcomes of an online co-design workshop involving all partners and held at the beginning of this WP.

At the end of this WP, the following conclusions may be drawn:

1. Legal limitations regarding operability across territorial boundaries, and the frameworks for data privacy and security play the most critical roles in the implementations of MaaS. The former is an element relatively undiscussed when addressing MaaS.
2. On the other hand, the ownership model, which is a recurrent topic for MaaS, seems to have a lower relevance than expected. Apparently, it is only the data component the one that pose a point of conflict for those models.
3. When looking at future alternative scenarios of MaaS in Europe, market competition and public support to the development of open data and open APIs are identified as the factors with the highest impact and highest uncertainty in terms of future development of MaaS. Therefore, four scenarios were built from the combination of these two factors with the identified two opposites outcomes (APIs are private, not accessible, not standardized vs APIs are open, public, standardized and accessible; market monopoly vs fair competition). All the remaining factors related to citizens behaviour, policy and legal framework, technology available, and so on, were also used to create scenario narratives. The four scenarios were named: Mobility Walled Garden; Open Data Power in Stand By; Everyone on their own; Open Ecosystem).
4. A set of actions to tackle the challenges arising from each scenario was also identified. However, it represents only a starting point for the definition of a clear set of recommendations to roll up large scale implementations of MaaS in European cities.

It is important to point out that the four scenarios generated during the workshop are plausible scenarios, but of course they are not the only possible ones. By providing general frameworks to speculate on possible futures and to understand the factors that could have a major influence in MaaS future development, they enable us to ask “What if” questions and consequently reflect on how decision makers can make better decision today to avoid undesirable futures. Beyond this, there is a need for a deeper of the wider implications from each scenario and a detailed analysis of the potential initiatives, decisions, or investments to secure and strengthen the MaaS market.
8. References


ERTICO – ITS Europe (2019) Mobility As a Service (Maas) and Sustainable Urban Mobility Planning.


Kao, P.-J. et al. (2020) *Analysis of best practices and leading initiatives in regulatory policies and governance models. Deliverable of the Project Policies and Regulations required for enabling the MaaS concept (ProMaaS)*.


Annex

A1. List of Workshop Participants

Valeria Caiati, Eindhoven University of Technology (organizer and facilitator)
Maria Conill de Azpiazu, Area Metropolitana de Barcelona
Debbie Dekkers, City of Amsterdam
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Beatriz Huarte Fournier, Barcelona City Council
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Sami Sahala, Forum Virium
Daan van der Tas, City of Amsterdam
Vladimir Vorotovic, Ertico
Joel Wolff, Aalto
Carolin Zimmer, Technische Universität München
A2. Workshop Agenda

1st day, 19th October 2020

• Introduction (9.00)
  o Welcome
  o Short round of introduction
  o Introduce the project aims and objectives
  o Introduce the workshop program and main approach
  o Introduce the MIRO platform and warm up with a quick exercise
• Validate scenarios factors (9.30)
• Break (10.00)
• Determine roles (10.15)
• Determine uncertainties (11.00)
• Break (11.45)
• Develop axes of uncertainties (12.00)
• Discussion, feedbacks and next steps (12.50)
• Close (13.00)

2nd day, 20th October 2020

• Revise and finalize axes of uncertainties (9.00)
• Opening session with all the groups (9.30)
• Introducing scenario building (9.35)
• Revise axes of uncertainties in groups (9.40)
• Plenary session for scenario building (9.50)
  o Presentation of axes of uncertainties by each group
  o Short round of discussion
  o Vote the two axes of uncertainties
  o Agree the scenario matrix
• Break (10.30)
• Scenario description - group session (10.45)
• Short round of scenario presentation - plenary session (11.30)
• Break (11.45)
• Governance actions - group session (12.00)
• Discussion and feedbacks (12.30)
• Close (13.00)