



**MOBILITY AS A SERVICE
(MAAS) AND
SUSTAINABLE URBAN
MOBILITY PLANNING**

Imprint

About:

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Authors:

Lidia Signor and Piia Karjalainen (ERTICO – ITS Europe), Maria Kamargianni and Melinda Matyas (UCL – MaaS Lab), Ioanna Pagoni (University of Aegean), Tito Stefanelli, Giuseppe Galli and Patrizia Malgieri (TRT), Yannick Bousse (UITP), Vasilis Mizaras and Georgia Aifadopoulou (CERTH), Suzanne Hoadley (Polis Network), Marijke De Roeck and Katia Kishchenko (City of Antwerp), Thomas Geier (EMTA).

Reviewers:

Isabelle Vandoorne (EC - DG MOVE), Sami Sahala (City of Helsinki), Siegfried Rupprecht (Rupprecht Consult)

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Contacts:

ERTICO – ITS Europe, Blue Tower – 2nd Floor, Avenue Louise 326, 1050 Brussels, Belgium, www.ertico.com, Tel. +32 (0)2 400 0700, info@mail.ertico.com

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Guide to the reader

This document provides guidance on a specific topic related to *Sustainable Urban Mobility Planning (SUMP)*. It is based on the concept of SUMP, as outlined by the European Commission's Urban Mobility Package¹ and described in detail in the European SUMP Guidelines (second edition)².

Sustainable Urban Mobility Planning is a strategic and integrated approach for dealing with the complexity of urban transport. Its core goal is to improve accessibility and quality of life by achieving a shift towards sustainable mobility. SUMP advocates for fact-based decision making guided by a long-term vision for sustainable mobility. As key components, this requires a thorough assessment of the current situation and future trends, a widely supported common vision with strategic objectives, and an integrated set of regulatory, promotional, financial, technical and infrastructure measures to deliver the objectives – whose implementation should be accompanied by reliable monitoring and evaluation. In contrast to traditional planning approaches, SUMP places particular emphasis on the involvement of citizens and stakeholders, the coordination of policies between sectors (transport, land use, environment, economic development, social policy, health, safety, energy, etc.), and a broad cooperation across different layers of government and with private actors.

This document is part of a *compendium of guides and briefings* that complement the newly updated second edition of the SUMP Guidelines. They elaborate difficult planning aspects in more detail, provide guidance for specific contexts, or focus on important policy fields. Two types of documents exist: While 'Topic Guides' provide comprehensive planning recommendations on established topics, 'Practitioner Briefings' are less elaborate documents addressing emerging topics with a higher level of uncertainty.

Guides and briefings on how to address the following topics in a SUMP process are published together with the second edition of the SUMP Guidelines in 2019:

- **Planning process:** Participation; Monitoring and evaluation; Institutional cooperation; Measure selection; Action planning; Funding and financing; Procurement.
- **Contexts:** Metropolitan regions; Polycentric regions; Smaller cities; National support.
- **Policy fields:** Safety; Health; Energy (SECAPs); Logistics; Walking; Cycling; Parking; Shared mobility; Mobility as a Service; Intelligent Transport Systems; Electrification; Access regulation; Automation.

They are part of a growing knowledge base that will be regularly updated with new guidance. All the latest documents can always be found in the 'Mobility Plans' section of the European Commission's urban mobility portal *Eltis* (www.eltis.org).

¹ Annex 1 of COM(2013) 91

² Rupperecht Consult - Forschung & Beratung GmbH (editor), 2019 Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, Second Edition.

Executive summary

As the integration of various forms of transport services into a single mobility service accessible on demand, Mobility-as-a-Service (MaaS) may be a valuable ally for decision-makers and planners in cities to reach their mobility goals. Multimodal and user-centric by nature, MaaS may very well have the potential to provide an attractive and efficient alternative or addition to private car use and to promote a shift towards sustainable transport modes and a more efficient use of transport networks. Therefore, MaaS is seen as a tool for the reduction of congestion and negative environmental impacts as well as for the renaissance of more lively urban areas and connected communities.

For those cities willing to introduce MaaS in their areas, this practitioner briefing provides the elements to understand what MaaS is, to assess the readiness of their city and to explore possible operational and governance options and models. As MaaS is based on the use of local transport infrastructure and combines various services it requires an integrated planning approach, based on the use of local ingredients. MaaS

can bring new tools to analyse and monitor the mobility situation, encourage sustainable choices as well as engage with stakeholders and the citizens. It also brings a new set of measures for public authorities, such as widen stakeholders' engagement and data sharing management, depending on the possible different roles they can play in the public-private partnership that is at the heart of MaaS development. Public authorities must also be aware that, even if it is relevant to plan SUMP process and MaaS implementation hand-in-hand, MaaS also implies policy, regulation and technical elements that go beyond the SUMP process and/or local authorities' competencies.

This Practitioner Briefing will introduce the concept of MaaS and the importance of integrating it into the Sustainable Urban Mobility Plan (SUMP) procedure, through the 8 SUMP principles and the 4 phases of the SUMP cycle, followed by an explanation of the key tools for planners, for a striving MaaS development, supporting the policy goals of the city.

2 Introduction

Urban mobility is going through some significant changes. There are several problems created by the rapid influx of people into cities such as the growth in traffic volumes, resulting in increased congestion, emissions and pollution. On the other hand, there are more and more mobility options available, as car sharing, bike sharing, on demand transport, and ride hailing are now becoming more commonly available in many urban areas. More recently, we have seen the accelerated introduction of shared micromobility in cities, including scooters, electric bikes, electric scooters and electric mopeds. The widespread availability of such a palette of new mobility services together with the traditional modes, such as public transport, creates a complex mobility environment. Together these solutions bear huge potential, if the overall focus can be shifted from a solo-modal approach to a multimodal optimisation of the transport system. Although still emerging, Mobility as a Service (MaaS) has the potential to deliver the benefits of the multimodal system.

This briefing focuses on the most critical aspects that should be considered by public authorities, if they want to enable MaaS and use it to introduce new tools for an improved and comprehensive mobility management strategy and sustainable urban mobility planning.

The remainder of the guide will:

- Help to understand what MaaS is (Section 2.1) and what the opportunities and challenges are (Section 2.2);
- Describe the special features of MaaS and how it should be integrated into sustainable urban mobility planning (SUMP) following the 8 SUMP principles (Chapter 3);
- Describe the relevant elements to take into account in relation to the 4 phases of the SUMP cycle (Chapter 4);
- Provide guidelines to assess the preconditions of MaaS implementation in a city (Chapter 5);
- Present different MaaS operational and governance options and models (Chapter 6).

Mobility as a Service is dependent on the existence of a range of transport solutions involving infrastructure management, end-user services, data and access to relevant systems, for example booking and ticketing

systems. This briefing should therefore be considered alongside the other SUMP guides and briefings, especially the ones focusing on ITS, shared mobility services, walking and cycling, parking and the use of real time data.

This connection is especially evident with the ITS guide as its component technologies are among the main enablers for MaaS, in particular supporting the better use of available resources and capacities and facilitating user access to multimodal services. The reverse is also important as information from MaaS services can supply key data for urban traffic and travel information, as well as traffic management.

As the development, roll-out and effective implementation of MaaS rely heavily on the availability and management of data, the questions around data sharing and related business models should be considered as a part of the urban mobility toolkit. Therefore, they also receive a lot of attention in this guide.

2.1 Mobility as a Service

2.1.1 MaaS definition

Although Mobility as a Service (MaaS) is a concept that has received high levels of interest in the transport sector both from the public and private sector, there is not yet a commonly agreed upon definition. A first consensual definition among public and private organisations was provided in 2017 by the White Paper of the MaaS Alliance³:

“MaaS is the integration of various forms of transport services into a single mobility service, accessible on demand. For the user, MaaS offers added value through the use of a single application to provide access to mobility, with a single payment channel instead of multiple ticketing and payment operations.”

More recently, in mid-2019, the European Metropolitan Transport Authorities (EMTA) described MaaS this way⁴:

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

The UITP, as the international organisation for public transport authorities and operators, also defines MaaS as follows⁵:

“Mobility as a Service (MaaS) is the integration of, and access to, different transport services (such as public transport, ride-sharing, car-sharing, bike-sharing, scooter-sharing, taxi, car rental, ride-hailing and so on) in one single digital mobility offer, with active mobility and an efficient public transport system as its basis. This tailor-made service suggests the most suitable solutions based on the user’s travel needs. MaaS is available anytime and offers integrated planning, booking and payment, as well as en route information to provide easy mobility and enable life without having to own a car.”

MaaS Lab⁶ of the University College London (in this document UCL - MaaS Lab) brings a definition with terms that we will use in this document:

“Mobility as a Service is a user-centric, intelligent mobility management and distribution system, in which an integrator brings together offerings of multiple mobility service providers, and provides end-users access to them through a digital interface, allowing them to seamlessly plan and pay for mobility.”

Several useful terms for the MaaS concepts are presented in Annexes (table 1).

³ MaaS Alliance, White Paper “Guidelines & Recommendations to create the foundations for a thriving MaaS Ecosystem”, 2017.

⁴ EMTA, A perspectives on MaaS from Europe’s Transport Authorities, 2019.

⁵ UITP Report Mobility as a Service, April 2019

⁶ Kamargianni, M., Matyas, M., Li, W., Muscat, J., Yfantis, L., 2018.

⁷ For real-life examples, please see for instance: Whim www.whimapp.com, UbiGo <https://ubigo.me/about-ubigo-english/>, Rejseplanen https://www.rejseplanen.dk/webapp/index.html?language=en_EN or Ustra <https://www.uestra.de/en/>.

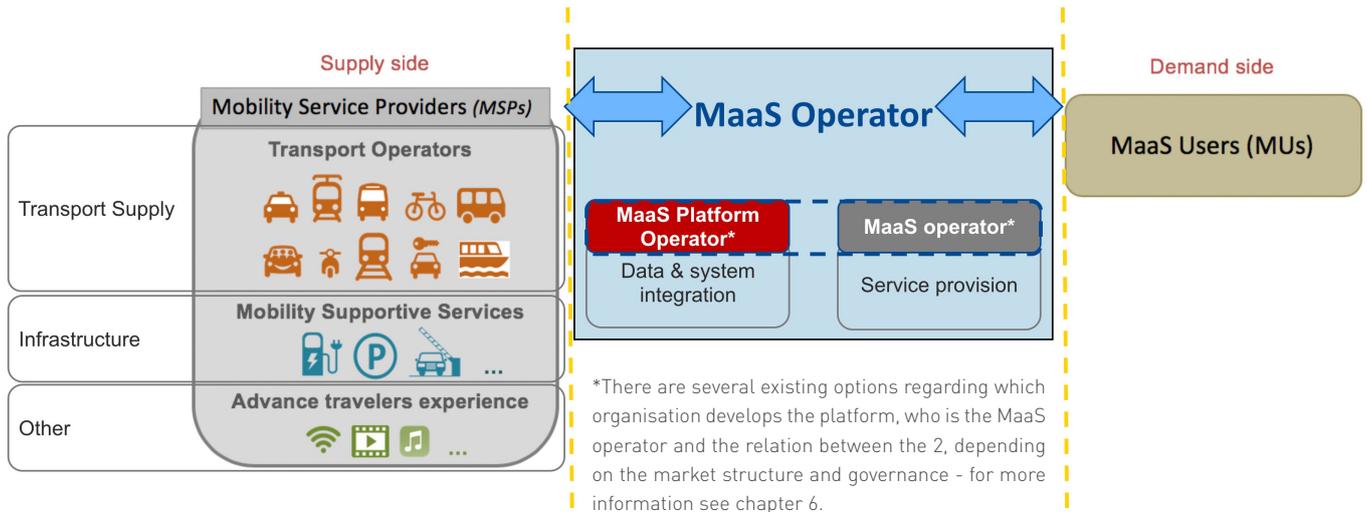


Figure 1: MaaS concept (elaborated from the elements of UCL-MaaS Lab).

The essence of the concept is integrating various services and providing them to users via a single means. The integration and the unified service provision are undertaken by intermediaries that are between supply and demand, as illustrated in Figure 1⁷.

As illustrated in Figure 1, the supply side is made up of Mobility Service Providers (MSPs), which are any public or private organisations that provide transport capacity (transport operators) or mobility related services such as parking services. The core providers are transport operators that supply services such as public transport, car sharing, carpooling, on-demand services and many more. A MaaS service does not contribute to the creation of additional transport capacity but integrates existing capacity from these underlying transport modes. Shared mobility services⁸, such as bike sharing, car sharing, e-scooter sharing, ridesharing have an important role to play within MaaS.

However, sometimes this creates some confusion in terms of the definition as frequently, various individual shared mobility services are referred to as MaaS. As stated in the definitions, MaaS is about integration and bringing together multiple mobility service providers into a single service; as such, a single sharing scheme, on its own should not be considered MaaS. Shared mobility and on demand services serve as a solution for the first/last mile problem and can supplement traditional public transport in situations where public transport alone cannot fulfil the user’s unique needs. Shared modes, alongside public transport and any new mobility solution together round out a comprehensive transport supply that can provide a viable alternative

Further guidance on shared mobility can be found in the **Practitioner Briefing Integration of shared mobility approaches in sustainable urban mobility planning** (<https://www.eltis.org>).

or addition to private vehicles⁹. Public oversight and effective governance is necessary to ensure such complementation of public transport and to control for the risk of substitution of public transport journeys by shared and new mobility services in areas where this is undesirable from a sustainable city perspective.

While currently only transport operators are considered in the supply side, other companies could also enter the MaaS arena. For example, mobility supportive services providers (such as fuel providers, parking or high-way operators, mobile phone charging), and entertainment services providers (such as Wi-Fi providers or movies and games providers) that could enhance the travel experience of users, could be considered as MaaS suppliers as well¹⁰.

⁸ For more information on these, please visit the CIVITAS PROSPERITY guideline on Shared Mobility and SUMPs.

⁹ Kamargianni, M., Matyas, M., Li, W., and Muscat, J. 2018.

¹⁰ Kamargianni, M., Matyas, M., Li, W., Muscat, J., Yfantis, L., 2018.

Switching from driving to travelling by train, for example, can already free time for users to consume services and offers designed for enhanced user experience. Once the MaaS Operators start offering their services, more and more ideas will surface to improve user experience. In addition, all these services will make even more sense in the autonomous vehicle era¹¹, as it is expected that travellers would have the opportunity to do plenty of other activities instead of driving.

The **MaaS platform** is a collection of components which perform integral functions such as data import, data storage, journey planning, optimisation, ticketing, payment and communication. These functions allow users to plan multimodal journeys, to book transport assets, to receive on-route guidance and re-booking suggestions in case of disruption, and to pay for the journey in a unified manner. Relevant data concerns, amongst others, locations of public transport stations, routing and timetable information, real-time location of trains, busses, shared-cars and bikes, location and pricing information of ride-hailing services and the respective booking and payment systems of the various modes.

integrated mobility offer. Payment plans for users of MaaS services may range from a pay-per-trip/pay-as-you-go offer to partial or full subscriptions. Many innovations are also foreseen regarding the payment options and incentives. In a mature MaaS service, the MaaS Operator could propose the ideal combination of transport modes for each trip by knowing the network conditions in real time (supply side) and the preferences of users (demand side). In other words, the MaaS Operator could also optimize the supply and the demand and contribute to efficient traffic management⁴ (see also focus on MaaS & Traffic Management in Chapter 4).

The **demand side** of MaaS are the MaaS users, individuals, households, user groups or companies¹². The demand side and users are a critical element of MaaS, as their diverse needs have to be well understood and met by the offerings of the MaaS Operator. One of the key components of MaaS is to provide more personalised mobility options and services, to match the users' individual needs.

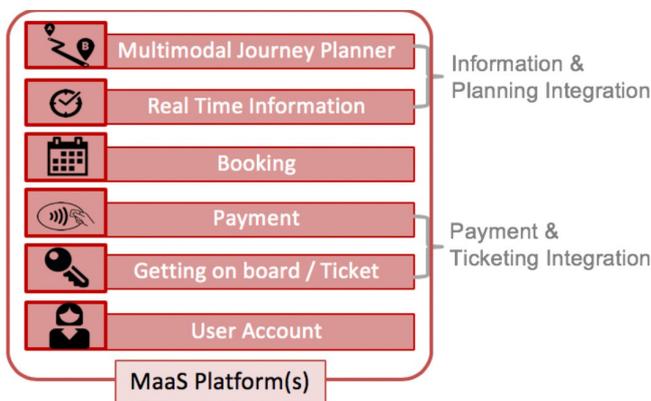


Figure 2. Function of the MaaS platform(s). Source: UCL-MaaS Lab.

The **MaaS Platform Provider** is the company responsible for providing the MaaS Platform. This could be the MaaS Operator or a third party responsible for just the technological elements. There are several existing options, which are explained more in chapter 6.

The **MaaS Operator** compiles the multimodal mobility service and offers it to the users via a digital interface (e.g. a smartphone app). The MaaS operator purchases transport capacity from the various transport service providers, recombines it and markets it to its users

¹¹ For more information on these, please visit the CIVITAS PROSPERITY guideline on Sustainable Urban Mobility Planning for Road Vehicle Automation.

¹² Freight transport could also be part of MaaS concept, but it is not in scope of this Briefing.

2.1.2 The MaaS ecosystem

An ecosystem of several actors from both within and outside of the transport sector should cooperate to offer MaaS. They include:

- MaaS operators
- transport operators and in general mobility service providers
- cities, transport authorities and infrastructure managers
- data providers and infomobility/application service providers
- technology and platform providers (technical back-end providers)
- ICT infrastructure
- payment system providers

- insurance companies
- regulatory organisations
- universities and research institutions
- investors.

A particularly important role in the development of a sustainable MaaS ecosystem needs to be assumed by the public administration, both at a local and national level, setting out policy objectives serving their community in close dialogue with other stakeholders. The administration should work with the global picture in mind and encourage the development of the service sector towards the provision of innovative services matching the users' varied needs.

2.2 Opportunities and Challenges

2.2.1 Opportunities

MaaS has the potential to bring various benefits to cities¹³. These, of course, depend heavily on the market structure and the chosen operational and governance model (see chapter 6), the specific MaaS service and the involvement and efficiency of all the actors within the MaaS ecosystem, including local/regional/national governments.

MaaS, by providing easier access to multiple transport services and facilitating more informed decisions about which mode(s) of travel to use in a certain set of circumstances, can reduce the need to use or own a car. In fact, users are offered the opportunity to choose transport product and combination of transport products that best match their requirements for each individual journey in an easy manner. MaaS can take into account user's general preferences concerning travel aspects like speed, convenience, comfort and cost, but also journey specific needs, for example a need to take along large pieces of luggage, a buggy or accessibility. This is particularly important for users with a momentary or permanent impairment to mobility. Moreover, the clear representation of all transport modes will make the actual cost of mobility more transparent and the efficient combination of modes may allow for cost saving possibilities for users compared to private car ownership. If access to mobility is easier and the use

and ownership of a car is less attractive in comparison, customers may be more inclined to use public transport and potentially to walk more or use a bicycle (to at least reach a public transport stop), i.e., they would use a wider range of transport modes and different modes for a trip¹⁴. Besides residents, these functions would also ease travelling for tourists, who are less likely to know and understand the complexity of the local transport system¹⁵.

MaaS holds potential to make better use of existing transport services and resources and it could also provide better intermodal connectivity within a region. While traditional public transport services, such as buses, trams and even taxis, are well utilised (even over-subscribed) in city centres during peak times, the same does not apply for the suburbs and rural areas and for services provided in the early morning or late evening/

¹³ For specific information, see: Kamargianni, M., Matyas, M., Li, W., and Muscat, J. 2018.

¹⁴ POLIS, Mobility as a Service: Implications for Urban and Regional Transport, 2017.

¹⁵ MaaS for tourists is being tested within the MaaS4EU project.

¹⁶ Kamargianni, M., Matyas, M., Li, W., and Muscat, J. 2018.

¹⁷ EMTA, A perspectives on MaaS from Europe's Transport Authorities, 2019.

night-time periods. If the data sources are unified and transferred between organisations within the MaaS ecosystem, improved network performance with more informed and reliable intermodal choices and travel times can be achieved. For example, a MaaS Operator could detect that there is high demand on certain routes during peak hours, and could redirect users to underutilised routes of other transport modes¹⁶. In the long run this can also help when deciding on the public investments, to be more efficient and useful for everybody¹⁷.

As the mobility becomes less dependent on ownership of often expensive transport assets, there could be benefits for social inclusion, reduced isolation and improved access to services, education, employment and social interaction¹⁸. The personalised approach of MaaS may offer inspiration for developing sustainable transport solutions for all citizens, especially those who find it difficult to use traditional public transport, such as the elderly and the disabled by easing access to door-to-door transport provision. Mobility provision is not only a fundamental right but also meets social and economic goals – it is widely acknowledged that keeping people active increases their physical and mental well-being. The level of transport service for people with reduced mobility can vary enormously from one area to another: dedicated solutions put in place tend to be organised and subsidised by public authorities or supported by volunteers as “traditional” services (public or private) tend to be too costly. Personalised services for vulnerable categories of society could fill the gap and improve access to mobility¹⁹.

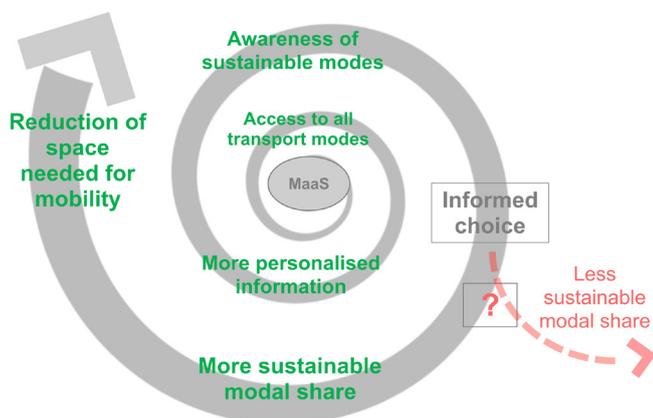


Figure 3. Virtuous circle of MaaS for more sustainable travel behaviour and mobility.

2.2.2 Challenges

Given the different circumstances in different cities and regions, it seems unlikely that a single MaaS model would be universally applicable. Cities and regions engaging with the MaaS concept need to have a clear strategic vision of how they intend to develop. This vision can be used to guide MaaS systems and improve collaborative partnerships with transport operators and private MaaS organisations, to ensure a MaaS system fits for policies and wider goals. A strong public-private partnership is a key (see Chapter 6 for details on the different operational and governance options and models).

From the city perspective the stress of MaaS on individual choice and reduction of barriers to transport access, may present also a risk of inducing an unfavourable mode shift. Therefore, public authorities need to engage to ensure that MaaS is contributing to their policy goals. A substitution of walking and cycling trips with public transport as well as a shift from public transport to car-sharing, taxi or taxi-like services, thus towards car-based modes, is typically considered unfavourable from a city perspective.

A certain degree of such an unfavourable shift, e.g. from public transport to car-based services, can be seen as evidence for the intended flexibilisation of mobility in which users choose their mode of transport based on their journey specific needs. However, in order to fulfil its promises and offset such unfavourable moves, MaaS will have to encourage a significant shift away from private car use to multimodality. Trust between the involved MaaS actors is an institutional issue for MaaS. In some cities, the tight competition among various stakeholders makes them unwilling to share information, expose their business models and thus collaborate with their competitors in the same MaaS scheme. In order to trust a MaaS provider who runs the platform, and join the integrated mobility offer, the business partners expect impartiality, fairness, an innovative strong brand and an integrator that is stable and trustworthy enough to stay for a long time²⁰.

¹⁸ EMTA, A perspectives on MaaS from Europe’s Transport Authorities, 2019.

¹⁹ POLIS, Mobility as a Service: Implications for Urban and Regional Transport, 2017

²⁰ UITP Policy Brief: Ready for MaaS? - Easier mobility for citizens and better data for cities, May 2019

All business partners should be treated with non-discriminatory manners and the access conditions to join the MaaS platform should be fair. Mobility service operators also need to have full trust that the MaaS provider will give a quality service to their clients.

As the development, roll-out and effective implementation of MaaS rely heavily on the availability and management of data, the questions around data sharing and related business models should be considered as a part of the urban mobility toolkit and strategy.

Public authorities and public transport operators may also suffer from the lack of resources (financial and human) in data management as this is has not been their core activity. In order to make MaaS happen, public authorities need to facilitate the access and availability of high-quality data and have to set the framework to ensure that they get an access to data from various (public and private) data sources themselves. Data is lacking common structure or format; similarly the lack of standardisation of data, both static and dynamic, is still an issue. The endeavour for more efficient data exchange has been facilitated also by the European Commission with the Delegated regulation

(EU) 2017/1926 on the provision of EU-wide travel information services, which implementation is now a first important step.

In order to integrate service into one service provision and unlock the potential of the new sale channel, MaaS Operator need to be able to purchase and sell the pass/tickets of mobility service providers, including public transport operators and new mobility services to its customers, and here some technological, commercial and regulatory challenges may apply. The first important technological requirement for MaaS implementation is the availability and provision of open and standardized Application Programming Interfaces (APIs) from the mobility service providers. Analogue systems, like paper based ticketing for example, but also legacy digital systems that are unfit for direct integration may need to be replaced for MaaS deployment. Solutions for this need to be determined at early stages of the MaaS development. Today, smartphones are the privileged interface with users but with the fast pace of technology, public authorities should keep themselves also open to other technological developments easy to use for different user groups.

3. The 8 SUMP principles in the context of MaaS

Building on existing practices and regulatory frameworks, the basic characteristics of a Sustainable Urban Mobility planning can be summarised in the following 8 principles according to the 2013 Urban Mobility Package.

The 8 SUMP principles will be addressed through an introduction of the specific key challenges the deployment of MaaS poses. The reader shall find the recommendations in Chapter 4.

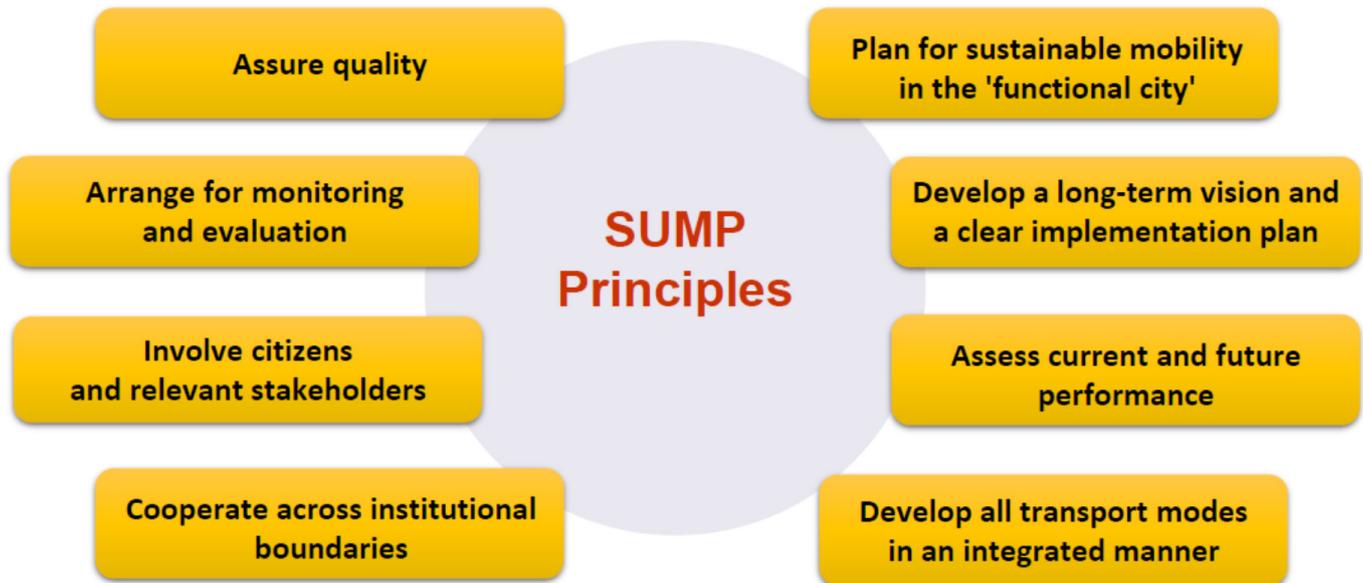


Figure 4. SUMP principles.

3.1 Plan for sustainable mobility in the 'functional city'

MaaS has the potential to provide an improved way to monitor, facilitate and influence mobility demand patterns and accessibility vis-à-vis the different needs of the citizens, foster multimodality and use of alternative means and services of transport. However, a special attention is needed in relation to incentives and data management, as well the integrated planning of modes to support an effective spatial, time and quality coverage of services. In fact, despite the need for a balanced development of services in both urban areas and suburban areas, it must be recognised that not all commercial service models are feasible in all parts of a city or region.

Challenges:

- How to support accessibility and convenience along the whole multimodal trip chain, in terms of infrastructure, services and travel information?

- How to connect and serve the outskirts where public transport operations are not viable nor commercial services feasible?

- How to prevent "cannibalism" of existing high-quality public transport services and ensure a balanced and sustainable transport supply where services are complementary and in good synergy?

- How to ensure the inclusiveness of the transport system, also in relation to digital access and capabilities?

- How to provide more personalised services for the whole 'functional city'? How to know more about the needs of those who has been underserved?

3.2 Develop a long-term vision and a clear implementation plan

In uncertain and changing times, particularly in case of a novel and complex concept as MaaS, the creation of long-term vision need to be combined with agile planning and implementation methods and constant learning-by-doing approach supported by pilots and wide knowledge and experience-sharing among stakeholders.

Challenges:

- How to determine the local and regional MaaS vision and the desired or necessary role of the various public authorities in the MaaS ecosystem?
- How to cope the various time perspectives in planning? How to move towards agile planning procedures?
- How to create commitment for a common vision across the administrative silos and public and private sector?
- How to clearly define and select the key measures for the introduction of MaaS?

3.3 Assess current and future performance

MaaS can bring a new tool for the assessment of the current and future performance of the urban and regional transport system, provided that adequate capacities, resources and institutional set-ups are in place. This concerns particular capabilities and systems for the collection and management of data and the use of this to create insights relevant for the evaluation framework on the impact of MaaS on aspects like travel behaviour.

Challenges:

- How to organise and support access to data and organised flows of data to assess and monitor performance of transport services and the system at large?
- How to deploy the digital tools to gather better understanding of the needs of users, both residents and tourists?

- How to know more about those that do not use the system? How to know more the “non-users” of public transport and bring them into a multimodal reality?

- What is the baseline against which progress can be measured?

3.4 Develop all transport modes in an integrated manner

MaaS can help planners in the balanced and integrated development of all transport modes by providing information about the transport network, service usage and performance. Demand and usage information gained through MaaS services can reveal, for instance, the need of a new or more tailored offer, for example in areas and/or times of low and dispersed travel demand. When seeking a more comprehensive multimodal approach the attention should be brought to the operational, regulatory and technical preconditions of:

- The integration of high-quality data, static and dynamic on networks and services (e.g. routes, schedules, availability of fleet, road works, traffic situation, disruptions etc.)
- The integration and interoperability of information, booking, payment and ticketing systems
- Market access of the new mobility services

Challenges:

- How to ensure the provision of high-quality data from different sources?
- How to foster interoperability of systems and services?
- How to overcome the challenges related to legacy systems and interoperability matters?
- How to create level playing-field for the market actors both at the side of transport production and the service delivery side?
- How to govern and integrate the new supplementing “pop-up” mobility services which might be coming and disappearing in cities almost overnight?

3.5 Cooperate across institutional boundaries

As MaaS has the vocation to go beyond a single urban area but also beyond national boundaries, it is important to collaborate with other institutional bodies at regional but also at national level. *A sustainable 'public value' MaaS ecosystem needs to be regionally structured to align with local context conditions while being internationally accessible to enable full mobility*²¹. Early engagement with all relevant administrative departments is particularly relevant when identifying how MaaS data (and often times location-specific including information about users' preferences and behaviour) could be used to support traffic management and city planning. Collaboration with other bodies, at regional but also at national and European levels, is also important in order to establish technical interoperability framework.

Challenges:

- How to support and incentivise the willingness of all mobility providers, public and private, to cooperate in a MaaS ecosystem?
- How to coordinate the MaaS development at urban and interurban and national and cross-border context?
- How to coordinate the interoperability measures at all levels, from local to national, up to European or even international?
- How to use advanced data-sharing and management models to support better informed traffic management, traffic and urban planning and vision of smart city?

3.6 Involve citizens and relevant stakeholders

As MaaS puts the traveller at the heart of the solution, citizen involvement is crucial, not only to raise awareness about MaaS but also to have them involved personally with MaaS schemes and be informed about the impacts, especially the environmental performance, of their travel behaviour. *The system does not simply need to further ameliorate travel for those in public transport but will have to attract citizens that do not yet utilise multimodal mobility and enable them to do so in a for them convincing manner*.²² Since MaaS integrates

publicly and privately operated services, there is a growing need for an institutional set-up that allows continuous cooperation and open dialogue with all market stakeholders within, but also beyond, the SUMP process.

Challenges:

- How to reach out to those that do not yet use multimodal mobility and public transport?
- How to ensure the inclusiveness of MaaS schemes, both in terms of physical and digital accessibility?
- How to facilitate a strong local Public-Private-People partnership?
- How to build a trustworthy and structured dialogue with stakeholders?
- How to find right partners and benefit from innovations?

3.7 Arrange for monitoring and evaluation

To cover the monitoring and evaluation needs in relation to MaaS, the organisation and management of mobility data requires an integration with various data sources and platforms e.g. traffic management, urban planning and city management platforms, with adequate resources and competences.

Challenges:

- How to organise trusted channels to gather data and monitor traffic situation and users' needs?
- How to use direct feedback options provided by the MaaS applications?
- Who is collecting which data: the municipality, the service provider or a third party?
- How to ensure the compliance with the General Data Protection Regulation (GDPR)?

²¹ EMTA, A perspective on MaaS from Europe's Transport Authorities, 2019

²² EMTA, A perspective on MaaS from Europe's Transport Authorities, 2019

3.8 Assure quality

The involvement of citizens and stakeholders, as well as other institutional partners to create awareness and determine the governance framework for MaaS is clearly key for the quality of the process. Another crucial element for quality is the evaluation framework of the impacts of MaaS. Finally, exchanging lessons learnt with other municipalities can reduce the possibility of repeated mistakes and increase the quality of the process, but also support the creation of common understanding and vision across geographical and administrative boundaries.

Challenges:

- How to involve key partners in feedback procedure?
- How to measure the impacts of MaaS?
- How to look for advice and best practises?

4. Sustainable urban mobility planning steps for MaaS

In the following, the main actions and elements essential for MaaS implementation are introduced, reflecting the phases of the SUMP cycle.



Figure 5. The 12 steps of Sustainable Urban Mobility Planning (SUMP 2.0) - A planner's overview. Source: Guidelines for developing and implementing a Sustainable Urban Mobility Plan (Second edition), Rupprecht Consult, 2019.

4.1. Phase 1: Preparation and analysis

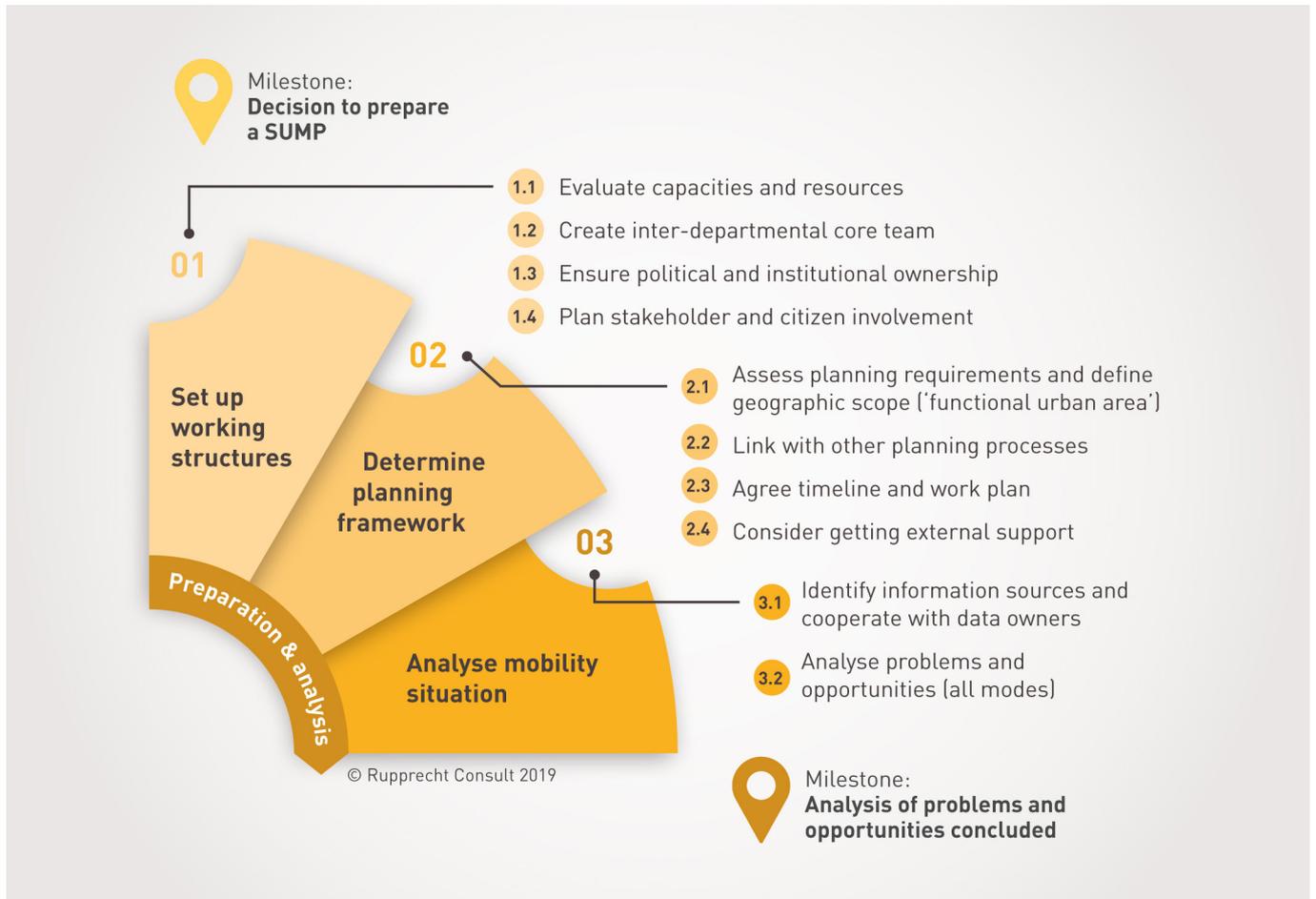


Figure 6. Phase "Preparation and analysis"

In the first phase of a SUMP, a few actions are recommended to prepare the process, in relation to the set-up of the working structures (Step 1) and the planning framework (Step 2) as well as the analysis of the mobility situation (Step 3).

Since MaaS integrates public and private-led services, there is a growing need for an institutional set-up that allows continuous cooperation and dialogue with all market stakeholders, from MaaS services and new mobility service providers to established market actors as well as market newcomers. Conditions and culture for this continuous and open public-private-dialogue must be ensured within and beyond the SUMP process in a technology-neutral and actor-agnostic approach. For a concrete example of dialogue, see the case of the city Antwerp with its Marketplace for Mobility, Section 4.4.

Different stakeholders have different perceptions and strategies in terms of governance, business and customer care in mobility. They also have different interests and objectives in being involved in the MaaS scheme. The city and/or the region should aim at bringing together the various stakeholders and after an open consultation build a common vision with right incentives and risk and profit sharing so that everyone can benefit. A culture of trust and the identification of potential benefits for each stakeholder is a key. Fair rules must be established to create a level playing field and engage newcomers.

While there is a need for certain minimum requirements to take part in the system, such as the control for solvency of service providers, lawful conduct, etc., participation in the ecosystem should generally be possible for any kind of actor on a non-discriminatory basis.²³

Administratively this can be supported by setting up an adapted working structure with multidisciplinary teams, to move from a siloed vision to an interoperable and interconnected picture. A more agile and experimental approach through pilots and projects, as well as a need for new capabilities and an internal coordination of relevant city departments and the SUMP team, especially in case of a specific MaaS or ITS/Smart City team is similarly recommended.

Moreover, it is critical to have a comprehensive plan for stakeholder and citizen involvement (see the case of the City of Helsinki, below).

When analysing the mobility situation, it is important to assess the availability of services and their level of integration and interoperability, market situation and national policies, technological readiness and, more generally, the readiness of the urban area to implement and use MaaS. As thoroughly explained in Chapter 5 through the MaaS Maturity Index developed by the MaaS Lab of UCL, there are a few preconditions for MaaS to happen, such as the presence of a variety of transport modes with broad spatial and temporal coverage.

Availability and sharing of the data are crucial for well-informed planning and decision-making procedures. To that end, working with open data and architectures as well as standard interfaces can help, and the establishment of a neutral platform for data sharing with an effective governance can be envisaged, if it is not available in the market. Data reciprocity can be imposed as a principle, from one side to improve the service level and usage of mobility services and on the other side to have up-to-date information for transport planners: aggregated, anonymized usage data (including demand data such as origin-destination requests) should be shared in a reciprocal way among cities, public transport authorities (PTAs), public transport operators (PTOs) and other mobility providers. The use of customer data should always be treated in compliance with the relevant legal requirements such as the General Data Protection Regulation (GDPR).

How the city of Helsinki is envisioning the citizen involvement in SUMP through MaaS?

The city of Helsinki is keen to focus on expanding the participatory approach in SUMP. Namely, this should reflect in providing the feedback 'loop' back from users of mobility to planning process. Transport planning is traditionally a top-down process. However, people are not content with that anymore. As behavior change is critical for the modal shift, cities need to look at new, more efficient ways to ensure it happens. Incentives or gamification must be integrated to the process that people are using to plan and manage all their mobility, every day. MaaS is playing a key role in that process. MaaS solution needs to provide a platform that cities can utilize in cooperation with MaaS operators, to launch and manage incentives and other innovative means to make alternative modes more attractive. This cooperation will then provide a key tool for not just behavior change or data collection, but the main platform to build participatory approach in providing citizens the primary way to communicate both quantitative and qualitative information straight back to planning process.

Source: Forum Virium / Helsinki

²³ EMTA, A perspective on MaaS from Europe's Transport Authorities, 2019

4.2 Phase 2: Strategy Development



Figure 7. Phase “Strategy development”

In the second phase of a SUMP, a few actions are recommended to prepare the process, particularly in relation of building and jointly assessing future scenarios (step 4), developing common vision and objectives with stakeholders (step 5) as well as setting targets and indicators (step 6).

The stakeholders and citizens involvement plan of Phase 1 is the basis for the active involvement of those categories and decision-makers to build the ecosystem of MaaS (as described in Section 2.1), but also to create awareness and a local vision. The local framework for implementing MaaS should be discussed according to the possible and desired governance and operational models as described in Chapter 6.

The participative processes including public, private actors, research institutions and customers could encourage all actors to debate elements such as risk

and profit sharing, data sharing and governance models and subsidy and incentives framework. This process could result for example in an agreed code of conduct.

The challenge for the city is to get all aforementioned stakeholders to work together towards a common sustainable mobility strategy. In this strategy, MaaS should be seen as a tool, for which a series of elements are commonly agreed and defined, such as its strategic objectives and incentive schemes. Regardless of the role the city and its administrative bodies in the MaaS implementation model, defining the overall strategy for MaaS is the responsibility of the public authorities, in a good dialogue with all stakeholders.

The objectives which are related to the strategy should be identified.

Key objectives might be²⁴, for instance:

- Increase modal share of more environmental friendly and efficient mobility options
- Reduction in private car use/ownership, reduction in kilometres by car (whether own car, taxi or shared vehicle)
- Improved mobility and access
- Equity
- Influence users' travel behaviour
- Engage the users in socially responsible behaviour within the community
- Improve air quality and health of citizens

MaaS is also seen as a tool to manage mobility demand and supporting the attractiveness of more sustainable modes. Since public transport is the backbone of sustainable mobility together with walking and cycling, public authorities need to ensure that public transport is available at the core of any MaaS solution, otherwise there is a risk of an adverse modal shift.

A significant shift to more sustainable means of transport (including cycling and walking) should be a relevant target while planning a MaaS policy. Gamification and nudging are elements of motivational techniques that can be used with rewards as an incentive for recognised sustainable travel behaviour, for example via bonus schemes, within the MaaS schemes. *Additional service features that exceed basic aspects of a multimodal journey (e.g. loyalty programs of commercial providers or soft nudging programs of public providers) should not be restricted whatsoever, as these provide ground for differentiation of services which makes multimodality more interesting to a wider public.*²⁵

However, it must be recognised that not every stakeholder in the MaaS system may automatically be interested in creating a shift towards sustainable modes out of itself, which is why effective MaaS governance needs to recognise the existence for such potential, unintended and undesirable effects. It depends on the market setup if the MaaS scheme is setup in a way that allows for profit to be generated by commissions on sales of certain transport products, these commissions may be highest in car based transportation (taxi, ride hailing,

car sharing) and may thus induce MaaS operators to steer customers to these services in order to maximize profits rather than towards sustainable modes. This potential effect is particularly pressing in the question of walking: There is no possibility to gain profits with steering people to walk rather than take a taxi, which leads to a potential disconnect between certain MaaS schemes and the sustainability goals of many cities. The public authorities should develop policies on the use of algorithms in order to safeguard a level playing field amongst transport operators and prevent undesirable effects such as a shift from collective modes to individualised modes or a shift from sustainable to motorised modes in the value propositions of MaaS solutions or route planners.

It is important to create an evaluation framework to enable impact of MaaS on travel behaviour to be measured against local transport policy goals. A MaaS-friendly policy in SUMP could be evaluated taking into account the modal shift and other related indicators (reduction in private car use/ownership, increase in public transport efficiency etc.). Key performance indicators (KPIs) as well as an adapted monitoring system must be in place to measure the efficiency and functioning of transport systems and should include feedback from residents and tourists. With a user-centric solution, such as MaaS, it becomes crucial to make the assessment also from the end user's perspective and include relevant indicators and targets.

Finally, it is important to keep in mind the interdependences between different measures and their relative indicators and targets. It is similarly important to pay attention to availability and quality of multimodal and accessible transport hubs and infrastructures, also in relation to new mobility solutions, as one of the key prerequisites of MaaS (see Chapter 5), contributing to its performance. Therefore, *from a public authority perspective, access to infrastructure and public space appears to be the most important instrument for facilitating and regulating the MaaS ecosystem and further aspects of the smart mobility transition.*²⁶

²⁴ See more in UITP Report Mobility as a Service, April 2019

²⁵ EMTA, A perspective on MaaS from Europe's Transport Authorities, 2019

²⁶ EMTA, A perspective on MaaS from Europe's Transport Authorities, 2019

Defining incentives strategy for MaaS

To fully unlock the potential of encouraging commuters to use more sustainable transport option, some further incentives strategies might be helpful. Gamification and nudging are elements of motivational techniques to be used with rewards as an incentive for recognised good travel behaviour. Further means of stimulating sustainable travel behaviour include bonus / loyalty schemes, where travellers are rewarded for using shared or eco-friendly modes. Rewards must be considered carefully – different segments may respond to different types of rewards such as free or discounted travel or partner discounts. Below are presented some incentive options that have the most potential:

- Promotional and/or push information; The user is pushed information on sustainable mobility alternative choices either at purchase phase or on trip.
- Financial incentives; for example, discounts, discount codes, free rides, taxation exemptions, discounts on added value services etc.
- City-wide loyalty schemes. This could include loyalty points won through use of sustainable mode choices
- Enhancing a socially responsible user profile; the user is motivated by getting awareness from the system of his/her socially responsible behaviour. Similarly, the user could be appraised for an active and healthier mobility user profile; for example, by using a bicycle or walking rather than driving car.

For more info please consult www.mycorridor.eu and in particular the outcomes of work package 7 on business models, incentives and legal issues, UITP's Mobility as a Service report (May 2019) as well as EMTA's paper on MaaS (June 2019).

MaaS Madrid: rewarding sustainable behaviour

EMT, the public transport operator owned by Madrid City Council, is launching a MaaS platform and a public-private alliance involving policy makers. This approach is key to ensure transparency in the route planner, to grant data protection for users and data analysis for transport system improvements. It will guarantee multi-modal options in combination with public transport and tackle challenges linked to congestion, air quality, accessibility, safety and equity. An example of this is the gamification system already developed in the first phase. Users collect more points for walking, cycling and using public transport than for others mobility options.

4.3 Phase 3: Measure Planning

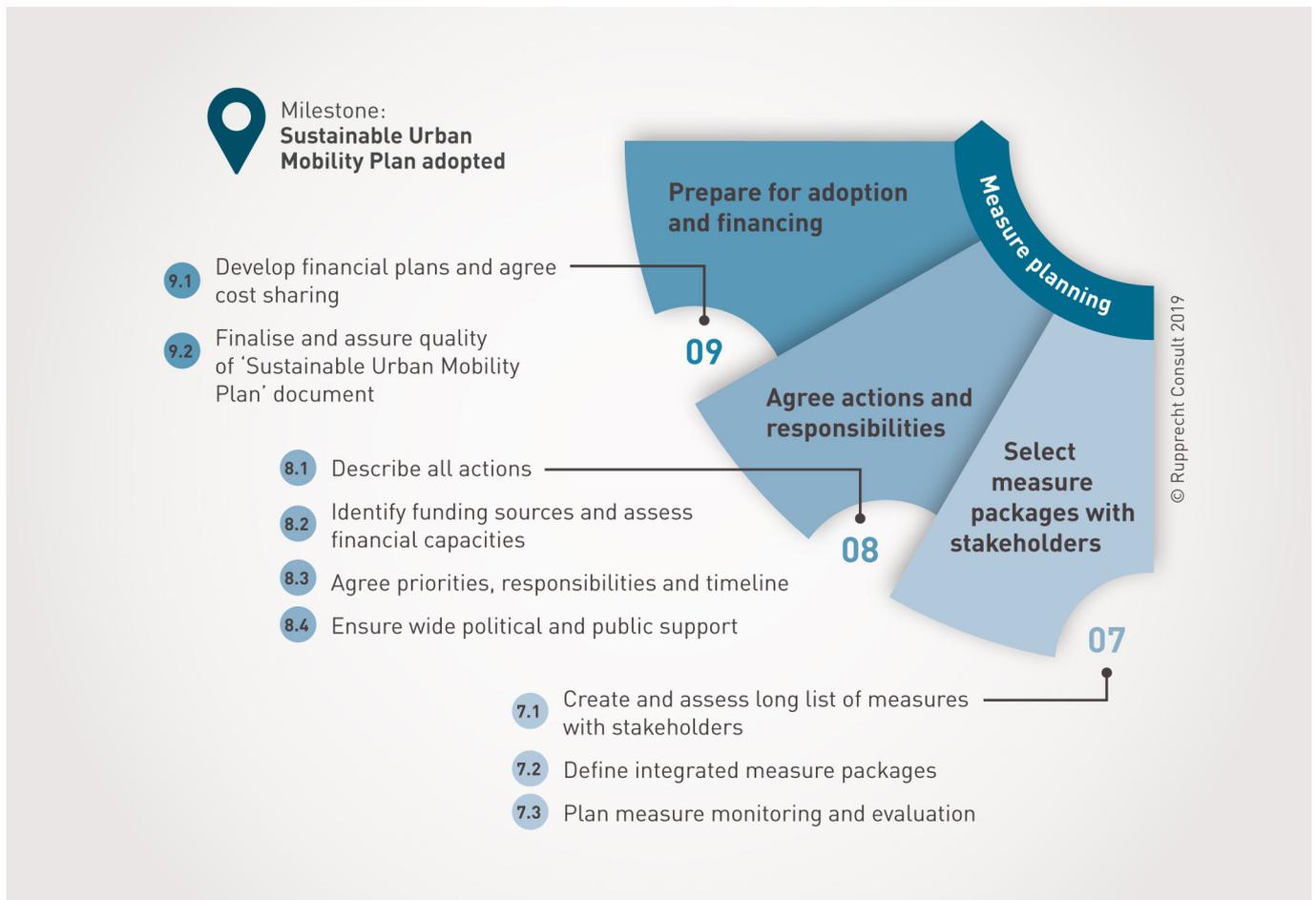


Figure 8. Phase “Measure Planning”

In the third phase of a SUMP, a few actions are recommended to prepare the process, particularly in relation to the selection of measures packages with stakeholders (step 7) and the agreement of actions and responsibilities and particularly public funding (step 8).

While actions and responsibilities in the MaaS scheme implementation depend greatly on the role taken by key stakeholders, as explained in Chapter 6, it is common practice to stimulate innovation, such as MaaS making funds available for trials and pilots, as this can be an important catalyst to inspire co-creation, to create awareness or to tackle technological obstacles.

In addition to various pilots, it might be useful to allocate public funding to ensure the preconditions to MaaS, as explained in Chapter 5 and evaluated in Phase 1. According to the analysis concluded in Phase 1, funding

might be also needed to build other preconditions, for instance, by modernising the booking and ticketing systems, supporting interoperability of services or by developing multimodal hubs. During this phase the public authorities could plan the migration from traditional traffic management to multimodal mobility management by exploiting the data exchange mechanisms a MaaS scheme can offer.

Public authorities should adopt and harmonize quality standards for all new mobility providers. They should develop policies on the use of algorithms in order to safeguard a level playing field amongst transport operators and prevent undesirable effects such as a shift from collective modes to individualised modes or a shift from sustainable to motorised modes in the value propositions of MaaS solutions or route planners.

MaaS & Traffic Management

Adopting the MaaS concept will institute a new stage in traffic management, where traffic optimization measures can also be provided by mobility service providers and used to enable some advanced services to the end-users.

In the future MaaS world, the traffic management operator, having access to dynamic traffic data (e.g. travel time, speed, traffic flow etc.) and collecting information about scheduled events by network operators and municipalities, will be able to provide traffic data services related to forecast travel time estimation, forecast level of services, as well as to perform interactive traffic management measures to optimize the traffic flow in the network. In such a scenario, if capacity levels drop (because of an accident or other incident) within the transport network and as such cannot be solved by traffic management measures alone, MaaS operators could be used to channel travel demand into a different travel mode or modes to optimize the flows in the network. Another example is that traffic managers increasingly use geo-fencing to control road traffic passing through designated parts of a network (i.e. residential/school areas, high polluting zones, hospital areas), MaaS operators can also enable the provision of geo-fencing by promoting sustainable modes to pass through such areas.

However, MaaS is not just an additional information channel to users, and traffic management is not just another source of mobility information. In fact, integration between the two applications may have increased impact on the mobility efficiency of the city. Through this enhanced collaboration, on one side, the traffic management operators can acquire dynamic traffic data directly via the connected vehicles, and then use the capacity of the whole transport system to spread travel demand more efficiently; on the other side, content/service providers and MaaS operators can enrich their mobility service suite with more contents to provide advanced and more precise services. Finally, the traveller acquires enhanced quality of service (e.g. less time wasted, increased comfort, less anxiety, fewer accidents). In this context, later on, it will also be worth studying how information from other sources, e.g. from transport service providers and fleet managers, could be used in order to optimise the traffic flows and management in cities, through traffic management measures and advanced data-based urban and traffic planning methods.

For more information: www.mycorridor.eu, www.tm20.org and paper referenced in Chapter 7.

4.4 Phase 4: Implementation and Monitoring

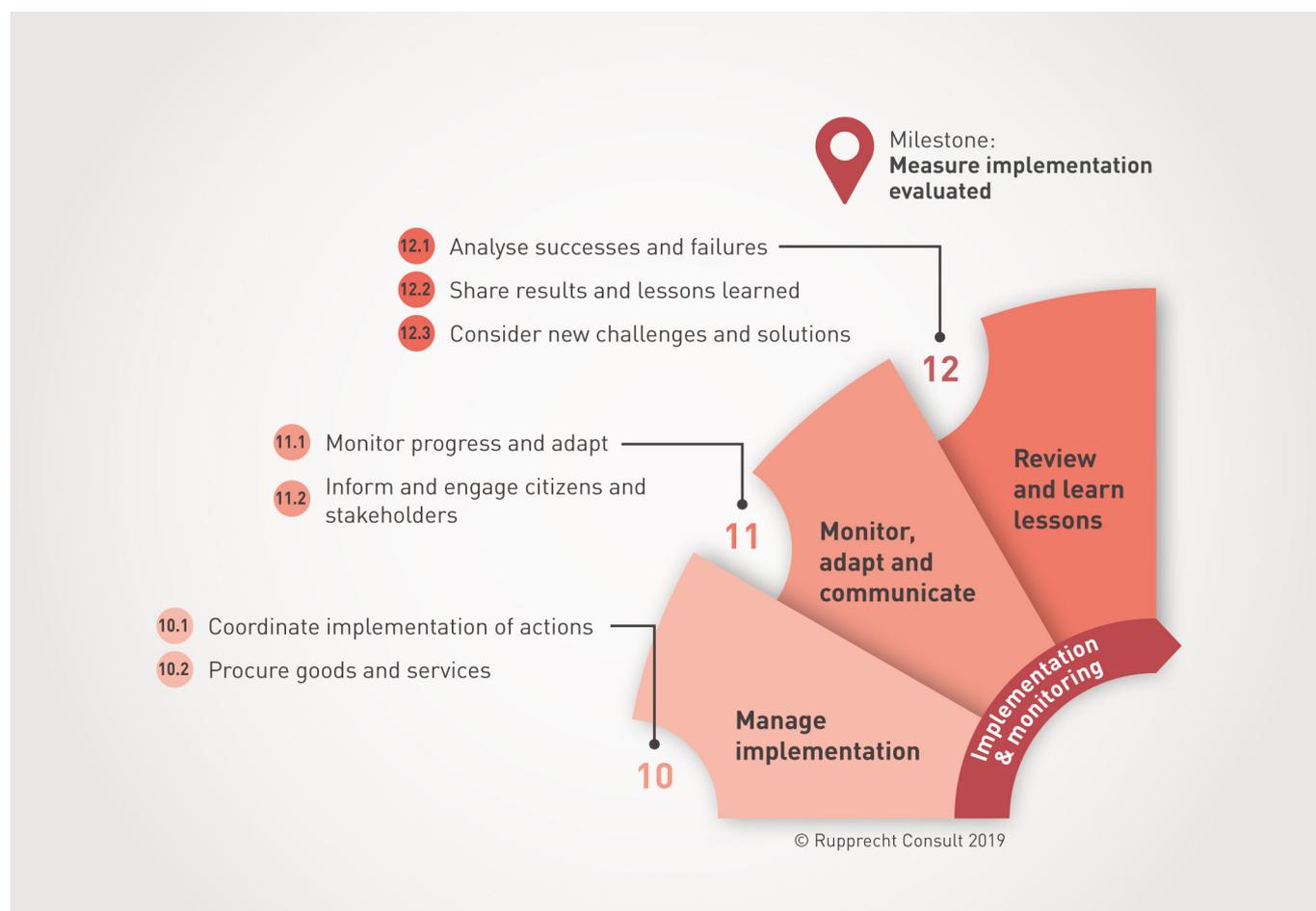


Figure 9. Phase “Implementation and monitoring”

In the fourth phase of an SUMP, a few actions are recommended to prepare the process, particularly in relation to the procurement step, to set up relevant organisational structures to manage the measure implementation to communicate, monitor and adapt, and to allow review and lessons learnt.

It is important to consider investments in pilots and programmes to jumpstart the ecosystem (Step 10 Manage implementation), but also to monitor progress and adapt, continuously engage with citizens and stakeholders, (Step 11 Monitor, adapt and communicate) and learn from experience (Step 12 Review and learn lessons). The implementation phase would most probably require the setting up of specific structures with allocated resources and relevant skills to cultivate a productive dialogue with the stakeholders, such as

the Marketplace for Mobility of the City of Antwerp, as explained on the next page.

Public procurement can play a role in encouraging (or discouraging) MaaS development. Innovative procurement could be used to ensure that the chosen solutions favour the user and do not create further bottlenecks or monopolies. In addition, public procurements (and Public Service Obligations, if applicable) can be used to set requirements for interoperability, data sharing or the use of open APIs. Early evidence shows that the choice of what to spend the budget on and what to procure depends ultimately on the MaaS model and that there is not only one way forward, as highlighted in the SPICE project on innovative procurement.

Finally, in the last SUMP phase it is important to monitor the indicators (Step 6) in order to evaluate MaaS progress and how it is contributing to the achievement of the defined objectives. If the analysis is in line with the expectations, it can be stated that MaaS is a winning solution.

Relevant elements to MaaS according to SPICE project on innovative procurement

Public procurement can be used to set requirements for availability of data and interoperability of services and fundamental infrastructures such as booking and payment systems. In this regard, procurement of such systems is very sensitive towards existing legacy and vendor locked-in systems, which create barriers for procurement and implementation. Keeping up with standards and open protocols ensures an efficient deployment as well as the possibility of interconnectedness of systems on site and interoperability of systems between sites. Public procurement can also be used to encourage open data by setting data sharing obligations in public tendering. Open interfaces (APIs) and open platforms encourage the involvement of smaller companies and their access to the mobility service provision. As a first step, publicly funded data registers (containing not-classified information) could be made available for academic and commercial developers and researchers. Public funding may be needed to compensate the expenses related to the establishment of registers (and open interfaces) and maintenance of the data storages if the data has been previously sold, if needed.

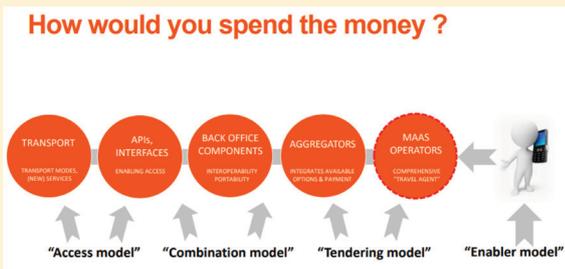


Figure 10. Different funded elements in MaaS, according to models: "Access model" is private-led, "Tendering model" is public-led while the "Combination model" is a public-private model. The "Enabler model" is another model where the public authority is "buying" the MaaS service. Source: presentation of Sami Sahala of Forum Virium Helsinki, Webinar on How to procure MaaS of the SPICE project, 27 September 2017. For more info on Financing and Procurement, please see the corresponding Topic guide on Financing and Procurement and the SPICE project website: <http://spice-project.eu>.

Smart Ways to Antwerp: creating a marketplace for Mobility as a Service

The City of Antwerp started the 'Smart Ways to Antwerp' project, in which it developed various measures and tools to accomplish a mind, modal, and time shift for passenger transportation and logistics in order to keep the city and port liveable and accessible.

At an early stage it became clear that the biggest obstacle for most people was being aware of all the mobility options already available and finding their way through the various itineraries and linking all the info together. Since no real multimodal travel planner was available, a new travel planner was developed supporting fully the goals of the city. This multimodal travel planner brings together the different transport modes offered within Antwerp combining cars, public transport, park and rides, shared bikes and walking. Assisted by the travel planner, the city can define certain user scenarios which should not be suggested (e.g. taking the car from within the city to the central train station) or certain parameters which should have more weight (attractiveness for Park & Rides). The next step in the travel planner's development will be to allow users to set preferences and filter results in terms of modes of transport (e.g. no car routes if you do not have a car).

While providing users with sound travel advice is crucial to changing their mobility habits, the proper and appropriate mobility solutions must also be in place. To ensure this, Smart Ways to Antwerp has set up its Marketplace for Mobility. The Marketplace brings together a wide selection of mobility providers and encourages the development of innovative solutions, such as Mobility-as-a-Service (MaaS).

In the 2017 project call, various MaaS-providers were selected to work together with the city. During 2018, the city of Antwerp helped them get in touch with mobility players, vouched for them toward public transport providers and helped them set up test audiences. It became clear that, although there were some serious technical challenges involved, finding the right way to influence behavioural change that is in line with the city goals requires close cooperation between the public and private sector.

In January 2019, Antwerp launched a MaaS-specific project call and will continue to nurture the MaaS ecosystem within the city. Together with the existing mobility players and MaaS experts, the city of Antwerp is building up its knowledge related to standardisation, reporting, technical requirements, and the user experience. Together, this information is creating a picture of what the end user really requires and how their needs might be addressed. Source: City of Antwerp.

5. How to evaluate and support cities' readiness for MaaS?

As MaaS is a complex solution, there are several key elements that should be in place to enable the successful creation of such an interconnected and integrated system that contributes to sustainable transport policy objectives. This is particularly relevant while analysing the mobility situation in Step 3 of the SUMP cycle (see Chapter 4).

Based on the MaaS Maturity Index developed by MaaS Lab²⁷ there are five core dimensions through which a city's potential to introduce MaaS can be assessed²⁸. These are shown in Figure 11 and each element is discussed below.

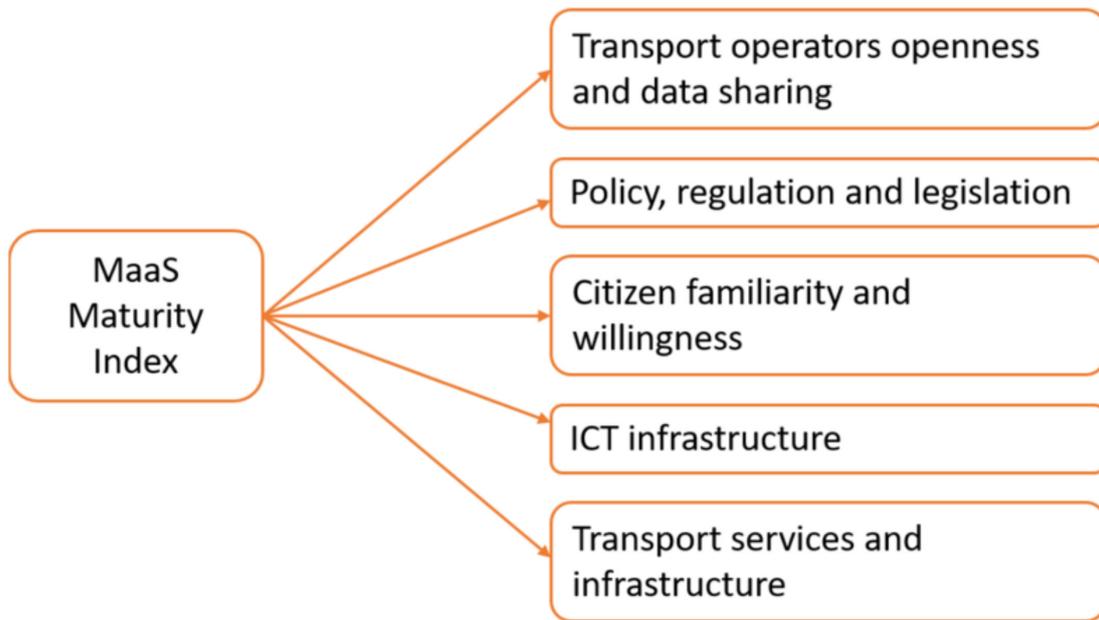


Figure 11. Dimensions of a cities readiness to implement MaaS (Source: UCL-MaaS Lab: MaaS Maturity Index)

5.1 Transport operators' openness and data sharing

Availability of APIs for journey planning, booking, ticketing and pricing data and interoperability of systems are prerequisites for the involved actors in a MaaS scheme. In order to benefit from integrated service offering and new sale channels, transport operators should be willing to open up and share their data with the MaaS Operator. The data is likely to be made available via APIs (Application Programming Interface), which are a set of procedures and tools for building software applications that interact with the features or data of another application or operating system. For example, access to the booking API of a transport operator allows MaaS Operators to use that transport provider's availability data and booking systems in their application.

Access to static data alone, such as timetables, would not suffice. Third parties, such as MaaS Operators, also need access to, for example, reserving seats, issuing verified tickets and unlock the shared bike.

Dynamic information regarding timetables, delays, disruptions and deviations are similarly necessary. In supporting the emergence of MaaS services, the most urgent step to take would be to ensure the access to

²⁷ Goulding and Kamargianni, 2018.

²⁸ Another interesting approach is "Mobility as a Service (MaaS) Readiness Level Indicators for local authorities" developed by the CIVITAS ECCENTRIC project and referenced in chapter 8- ANNEXES.

data/information in digital, machine-readable, non-proprietary format. It is also important that the data is reliable and shared securely.

5.2 Policy, regulation and legislation

Policy, regulation and legislation that enable and support MaaS are key to its successful implementation. In addition to the local framework, national governments, as well as the European Union, have an important role to play. Some important regulatory areas include data security and privacy, open data standards, third party ticket sales, market access of new mobility services, competition law framework and subsidization of transport. A specific regulation is the Commission Delegated Regulation (EU) 1926/2017 on the provision of multimodal travel information services.

As mentioned above, data sharing between the mobility service providers and the MaaS Operator (and vice versa) are critical for MaaS to exist. Transport operators may feel concerned about opening their data, as they see different perceived risks, e.g. according to UITP²⁹: losing the customer relationship, MaaS provider becoming the gatekeeper to all demand and usage data, disclosing the business model to competitors by sharing data or uncertainty that all transport operators are treated fairly by the integrator. These challenges need to be addressed when regulating. The quality and consistency of data shared and the data format are essential for MaaS. It must be easy for all mobility service providers, large and small players, to plug in the MaaS solution. Another area is the right for third parties to sell tickets on behalf of a transport operator - as in certain cities this is not currently possible.

Without regulations in place that allow this, the MaaS Operator would not be able to act as an intermediary between the mobility service providers and the users. In some countries, the regulatory framework prescribes that no third party is allowed to sell tickets other than the operator itself. Also, in several countries, pricing for public transport is regulated. It is also worth noticing, that in case the public transport operator (PTO) is in a position of market dominance, the chosen strategy (e.g. in terms of providing access to data or to existing ticket sales interfaces and the pricing practises) needs to be evaluated against the provisions and principles of competition law³⁰.

Government bodies should promote open data sharing

and implement policies and regulation that encourage mobility service providers to do so³¹. To facilitate this, data protection and security legislation has to exist to protect the users as well as the mobility service providers and the operators. For example, a customer's right to consent to having their data transferred from one operator to another should be covered. A further, and crucial element is the presence of stringent passenger rights (e.g. refunds for cancelled services) - as these will hold both mobility service providers and the MaaS Operator accountable for their actions³².

Public procurement can also be used to build precondition for MaaS by setting data sharing obligations and requirements for open APIs and interoperability in tendering procedures and when defining public service obligations.

The data derived from MaaS would help make more efficient use of existing infrastructures, improve the traffic management and help enhance sustainable mobility and public transport planning (independently or combined with more conventional data sources, like survey data). Therefore, when negotiating with the mobility service providers and MaaS Operators, the provisions of data sharing should also be covered.

5.3. Citizens familiarity and willingness

"Citizen familiarity and willingness" encompasses the extent to which citizens' lifestyles and behaviours align with a MaaS model of transport provision. This includes travel behaviour and use of MaaS related technologies. The core MaaS model is built around the use of a smartphone application and a variety of shared and active modes. Access to a smartphone and a debit/credit card are key for users to access and enjoy all elements of MaaS. That being said, there could be possible alternative solutions for those that do not own/have access to these technologies, and these will need to be examined in each implementation.

²⁹ UITP Policy Brief: Ready for MaaS? - Easier mobility for citizens and better data for cities, May 2019

³⁰ WA, Study on market access and competition issues related to MaaS, 2019

³¹ MaaS Alliance, "Data makes MaaS happen", 2018.

³² Kamargianni, M., and M. Matyas, 2017.

The current modal split and levels of car ownership in an area are also important indications of how easily MaaS will be adopted by citizens. A MaaS system will be able to provide a viable alternative to private vehicles in areas where there is a palette of alternative options, such as reliable public transport, car sharing/rental, taxi and shared micromobility. In regions where the use of these modes is already significant, citizens are more likely to adopt these within a MaaS system as well³³. In contrast, in areas that are predominantly private vehicle oriented, MaaS penetration will be much more difficult.

To include wider population segments and encourage behaviour change through MaaS (e.g. encourage car users to use other modes), further measures can be implemented in conjunction with the introduction of MaaS (e.g. combining MaaS and housing). Both the technologies and the modes that are inevitable for a successful MaaS offer are more easily adopted and preferred by younger generations, who are comfortable with technology and embrace the sharing economy³⁴. It is clear that certain population segments will be more inclined to adopt MaaS than others and this should be considered when developing MaaS.

In the MaaS ecosystem, every user is characterised by a unique identity, which is built on different attributes (their own set of personal preferences, financial profile, physical characteristics and past behaviours). New technologies make it easier to aggregate demand in a way that makes it possible to address a range of target groups, e.g. people with reduced mobility, people desiring tailored top-end services, and everyone in-between, instead of accepting a one-size-fits-all solution³⁵.

5.4. ICT infrastructure

For a MaaS system to be able to function, it relies on real time data transfer between the different actors within the MaaS ecosystem. Technologies that enable this, such as mobile network coverage and Wi-Fi, should be in place. Not all technologies are absolutely necessary, but the higher their availability, the easier a MaaS implementation will be. Mobile devices and reliable internet access is necessary for customers to be able to access digital platforms for planning, booking and paying for journeys as well as sharing data back to the MaaS Operator. In addition, ticketing/payment technologies such as NFC terminals, Wi-Fi and SMS payment solutions will allow customers to use their mobile devices to pay for all their journeys though

a single means. Cities might however require financial support to adapt and implement ICT infrastructures. Also, cities need to make sure that the services are digitally inclusive.

5.5. Transport services and infrastructure

Public transport is the backbone of the MaaS concept, complemented with other mobility services to provide a door-to-door solution³⁶. Demand responsive transport and shared mobility have a very important role to play as they can provide connections between locations not served by public transport as well as provide first/last mile solutions.

The sheer presence of an assortment of transport modes in itself will not be enough for a successful MaaS scheme. The density, frequency and integration of the different transport services into a seamless and frictionless service are important factors. The spatial coverage of the transport network is very important. There is no point in having an extremely dense transport network in the city centre if the residential sub-urban areas are left unserved. Temporal coverage is also important, meaning MaaS should be able to offer services throughout the day. Ideally, the MaaS service should cover all the daily, monthly and annual needs of the users.

The integration of a wide range of modes of transport into a seamless system involves the physical linking of multiple modes, routes and the calibration of schedules. An example of physical integration is providing parking, car-sharing stations and bike rental points at stations to enable multimodal journeys. Route integration is achieved by creating transfer points at strategic locations to ensure sufficient coverage of the network whilst preventing duplication of routes. Schedule integration is the harmonisation of the schedules of all modes of transport so that connections in multi-vehicle/multi-modal services can be made on time and with minimal waiting time. The quality of transfers between modes

³³ Matyas, M. and Kamargianni, M., 2019.

³⁴ Matyas, M. and Kamargianni, M., 2018.

³⁵ MaaS Alliance, "Recommendations on a User-Centric Approach for MaaS", 2019.

³⁶ Matyas, M. and Kamargianni, M., 2019.

is also important to users. This includes factors such as walking time between services, safety of amenities and disabled access. In order to promote the use of public transport and MaaS alternatives for tourists the availability of Wi-Fi at stations and during the journey is also an important factor.

Also, as mentioned before, analogue ticketing systems can be a blocking issue for the development of MaaS services. Given the benefits of integrated and multimodal services, enabled by digital technologies, ideally the ICT infrastructure and systems should be considered as a part of transport infrastructure to modernisation of which also public funding would be allocated from local, national and EU-wide programmes, if deemed necessary.



Further guidance on ITS, also as enabling infrastructure for MaaS, can be found in **“The role of Intelligent Transport Systems (ITS) in Sustainable Urban Mobility Planning”**

(<https://www.eltis.org>).

6 MaaS operational and governance options and models

6.1 No one model fits all

Before detailing the different options, it is important to note, that there is no single perfect solution fitting all environments. Each city and region need to evaluate which option works best for them, taking into consideration aspects such as the local conditions, the relationship between public and private sector actors, the available resources and the policy objectives. The MaaS Maturity Index, as presented in the previous chapter and the now introduced operational and governance model options should be used to decide the role of the city itself and set the framework for public-private-partnership. As suggested by UITP, for instance

the following factors can be used to evaluate how the options support the policy goals of the city:

- Increase public transport, walking and cycling use
- Number of users /Market penetration
- Threat of a private monopoly in the long term
- Social inclusion
- Innovation
- Customer orientation / usability
- Alignment with public policy goals
- Integration of local mobility providers
- Neutrality/Impartiality
- Sharing data back with public authorities

6.2 Operational and governance models

As mentioned above, there may not be a single solution that can fit all locations. Each case will be unique and adapted to the local environment. It is important to note that the potential for materialisation of the described MaaS benefits, and thus its alignment with public policy goals, may strongly depend on the chosen operational and governance model. The one question that is on everyone's lips is who will be the MaaS operator/integrator. But the key question is rather who is able to attract the maximum customers to produce the maximum benefits for sustainable and affordable mobility? Therefore the role of the integrator is to make MaaS fly. Only by having happy customers and happy business partners will a MaaS provider be able to scale and create maximum benefits for sustainable mobility. In the following subsections, three models or scenarios are presented, as in the UITP Report with additions from the EMTA paper, where relevant.

6.2.1 Private Integrator(s)

In the MaaS Model 1, commercial integrators act as MaaS Operators in the context of a marketplace with bilateral agreements with the transport operators. This model could be perceived as providing a more

customer oriented and innovative solutions encouraged by competition between integrators. From the policy perspective, the public authorities should closely monitor the market development and dynamics and consider if needed policy measures to ensure that the service provision supports social inclusivity and use of sustainable modes of transport. Policy measures might be also needed to support reciprocal data sharing between MaaS Operators, Mobility Service Providers and public authorities making the enhancement of transport services, traffic management and planning thanks to data analytics impossible. It is worth noticing that the algorithm has a big role to play in displaying the mobility options with various level of sustainability. A variation of this model could be that all transport providers, private or public are forced by law to open up their data and API's so that their services can be resold by third parties.

According to EMTA⁴⁰, the following benefits and inconveniences could be expected. As MaaS remains in the commercial domain most of the criticisms can effectively be addressed through effective regulation

⁴⁰ EMTA, A perspective on MaaS from Europe's Transport Authorities, 2019

and governance by regulators, which goes beyond the competencies of local public authorities. Therefore, it is important for cities to analyse their regulation environment to appreciate the real benefits and

inconveniences of this model, as well as actions required, such as a policy to ensure access to data for public authorities.

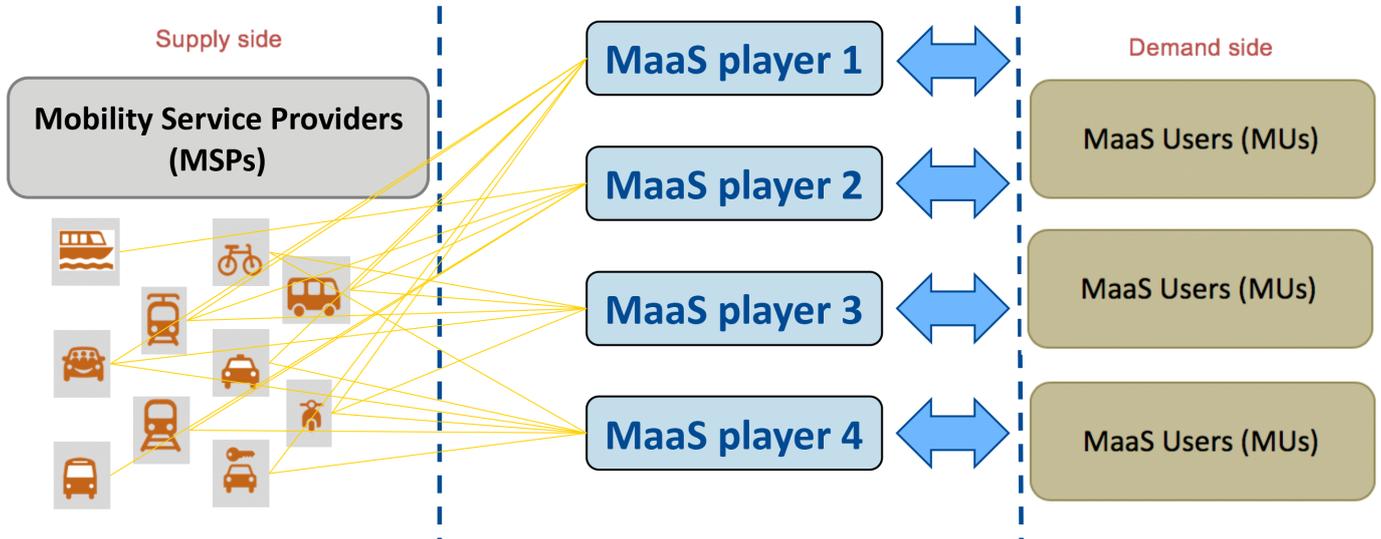


Figure 12. The MaaS Model 1 (elaborated from the elements of UITP Report, 2019, “Commercial integrator”)

Expected benefits	Expected inconveniences
<ul style="list-style-type: none"> • Variety of differentiated offerings also targeting different market segments • Better choice possibilities for users • Geographical scalability, possible through commercial organizations 	<ul style="list-style-type: none"> • Need for policy for data-sharing, important for informed policy making, regulation and effective infrastructure developments • High market entry barriers (contract negotiations with each Transport Service Provider, need for data and integration capabilities required) • Risk of reduced alignment of MaaS impact with societal policy goals because for-profit MaaS providers may seek to optimize their business cases through steering users towards transport modes and services where margins are highest (more likely to be with shared mobility and taxi-like services) • Risk of market dominance of “the winner takes it all”, negative for customers and further developments, with the creation of exclusive partnerships with transport service providers to protect market share in the competitive environment

6.2.2 Open Back-End Platform

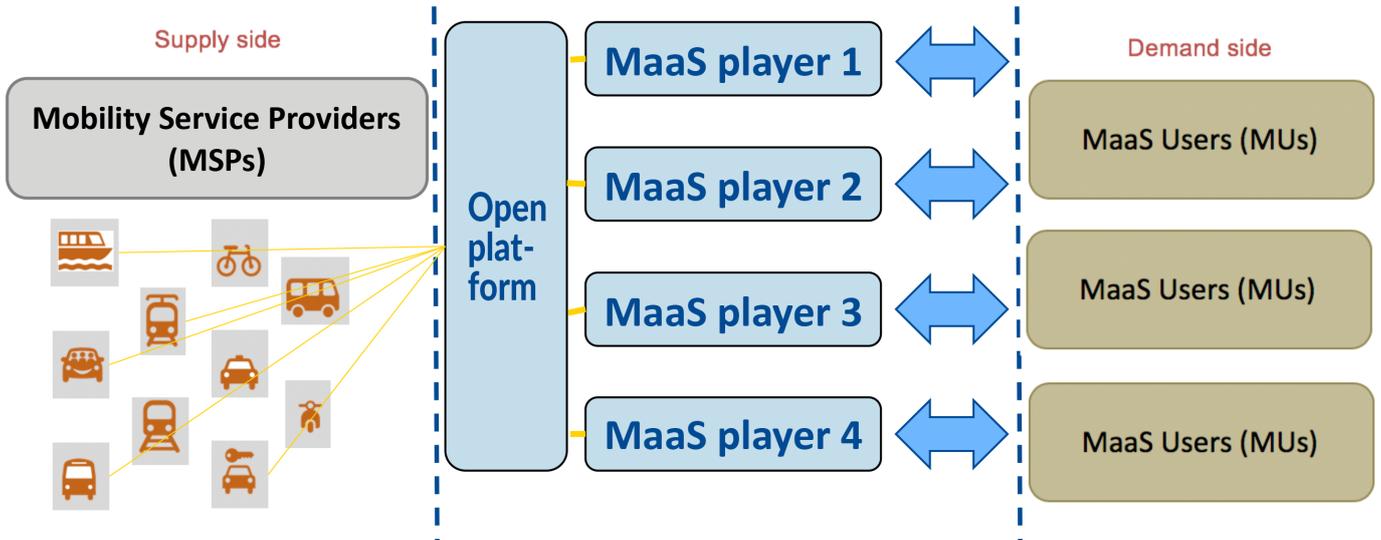


Figure 13. The MaaS Model 2 (elaborated from the elements of UITP Report, 2019, “Open back-end platform”)

In the MaaS Model 2, an open back-end platform would be set up by a public entity with rules determined by the public authority or another neutral party. The platform would serve as open infrastructure on which different MaaS providers could build a MaaS solution. All mobility services have to open up their API’s to be integrated in the platform. This model leaves room for competition to get the most customers and it is perceived as offering the possibility to provide a customer-oriented,

innovative and impartial approach. It would also integrate local mobility providers. The open back-end platform can be publicly established and funded or created by private service provider. The role of public authorities in this model is to ensure the common, fair and non-discriminatory rules for data sharing and to ensure that privileged position of data platform is not abused to create bottlenecks.

Expected benefits and inconveniences⁴¹:

Expected benefits	Expected inconveniences
<ul style="list-style-type: none"> • Variety of differentiated offerings that target different market segments • Better choice of possibilities for users • Scalability is possible since local, interregional and international service providers can enter the market • Low entry barriers: open, non-discriminatory access to integrated data and systems (e.g. ticketing, reservations, etc.) • Easier access to data for public sector • Overall, less risky and more controllable MaaS development by the public authorities 	<ul style="list-style-type: none"> • Risk of slow and bureaucratic processes • Dependence of the public authority on technology organisations to develop and maintain the platform, additionally, keeping up with the fast pace of technological advancement

⁴¹ EMTA, A perspective on MaaS from Europe’s Transport Authorities, 2019

6.2.3 Public Transport as the Integrator

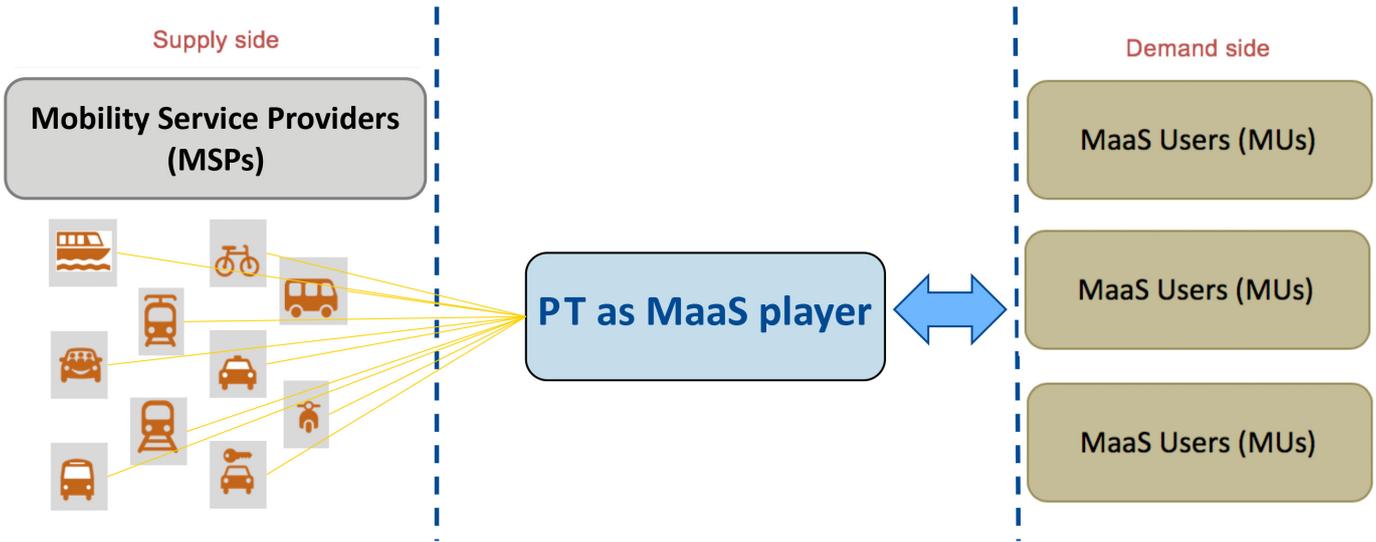


Figure 14: The MaaS Model 3 (elaborated from the elements of UITP Report, 2019, “Public Transport as the integrator”)

In MaaS Model 3, mass public transport would be the integrator. MaaS service could either be developed and operated entirely by the public domain or be awarded or licensed to a private organization for a specific amount of time. Since public transport in many cases has the largest customer data base and is the backbone of sustainable urban mobility, it makes sense for public transport to take the lead in integrating other mobility services. This will help public transport stay relevant to existing customers and be more attractive to new ones by becoming a real mobility provider. The basic building blocks of MaaS such as registration, trip planning, booking and billing have to be developed for the core

product regardless. Public transport is likely to be trusted by customers and other transport operators with regards to data protection, impartiality and stability. If the Public Transport Operator manages to integrate a solid selection of new mobility partners, this model has the potential to achieve the increase in sustainable mobility, be socially inclusive and best aligned on public policy goals. However, this model could also be perceived as providing a less customer-oriented and less innovative service if conventional public transport does not adopt a forward-looking approach, which may then hinder the attractiveness of services⁴².

Expected benefits	Expected inconveniences
<ul style="list-style-type: none"> - Easier regulation and protection of public value as a result of the close organizational or contractual relation between the public MaaS entity and the authorities - Easier access to data for public sector 	<ul style="list-style-type: none"> - Limited choices for users - A 'one approach fits all' MaaS offering developed by the public domain may not be aligned with the needs and preferences of citizens that are not currently users of public transport - Risk of private actors creating MaaS services without the integration of public transport, therefore more car-based, in response to the public monopoly, - Customers of this private competitive product would be unreachable for public transport - Lack of geographical scalability because the MaaS service would be covering the authority's jurisdiction - Legal criticisms in the frame of the European competitive law in relation to the roles and competences of authorities

⁴² UITP Report Mobility as a Service, April 2019

6.2.3 Other models

In addition to the 3 models seen above, the EMTA paper on MaaS also describes 2 additional major potential set-up scenarios, each one with potential advantages and disadvantages from the perspective of a metropolitan transport authority. In the Ecosystem Competition scenario, several mutually exclusive and vertically integrated mobility ecosystems compete with their own transport assets and their integrated mobility appli-

cation, resulting in high market entry barriers, vendor lock-in effects for customers and potentially dominant market position. In the Standardised Ecosystem scenario, however, the creation of a non-discriminatory level playing field through technology standardisation, e.g. APIs, seems to lower market entry barriers and allow public sector to access relevant data.

6.3 The open and inclusive MaaS

Inspirations for Open and Inclusive MaaS

This section presents a set of the criteria that each MaaS Operator, being from the private or the public side, should complete before entering the market of MaaS in Europe. It can serve as a set of best practices valid in most jurisdictions, though some of them could require additional compliance to local/national laws and requirements. The list is split into four domains

to cover different aspects of MaaS, including end-user, commercial, technology and privacy aspects.

Public authorities should use this tool as an inspiration when setting a framework, in dialogue with the market stakeholders, to ensure that the implementation of MaaS services results in the positive impact on city’s policy objectives.

<p>End-user</p>	<ul style="list-style-type: none"> • Ensure that the service provides equal access to all and does not discriminate against anyone • Provide an easily accessible and available customer service channel • Have in place clear procedural channels to address any complaints or issues that are raised • Have in place a clear policy for compensation or reimbursement for unsatisfactory services or when the trip is not carried out as planned • Provide clear and fair reasoning for the provision or denial of service • Offer multilingual services (both in local and international languages) • Provide accessibility and assistance at no additional cost for disabled passengers and passengers with reduced mobility • Provide information before purchase and at various stages of travel • Provide clear, accurate and consistent information, allowing consumers to make sound and efficient travel decisions • Fulfil the transport contract in case of disruption: mechanism for rerouting and rebooking • Provide clear and consistent information regarding the fares and fare structure for services offered
<p>Commercial</p>	<ul style="list-style-type: none"> • Adhere to EU Competition law under which the following practices are prohibited: (i) Illegal contracts and agreements (for example, market sharing) and (ii) Abuse of a dominant position (for example, discriminating between customers) • Clearly define and agree roles and responsibilities in the provision of services with local operators through service agreements and legal contracts • Align with the common European standards
<p>Technical</p>	<ul style="list-style-type: none"> • Provide a reliable platform with mechanisms in place to deal with system failures • Ensure services are provided via multiple platforms • Provide multiple secure payment options

Privacy	<ul style="list-style-type: none"> Provide privacy policy that is available and accessible to users Be in line with GDPR in terms of data storage and protection Ensure that no personal data is used without explicit consent from the user. Consent must be freely given, with clear explanation of what data is being collected, who is collecting the data and what the data will be used for Provide the option for users to opt-out from the data being collected
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Exercise for Practitioners

Use the below box to build the MaaS operational model or models that better fit to your city. While doing this exercise have in mind:

- What are your objectives and most desired impacts?
- What is the most prominent combination for your city given the current situation (starting point)?
- What is the most prominent combination for your city for the future?
- Is the required data available? Do some mobility service providers stay outside due to unavailability of data?

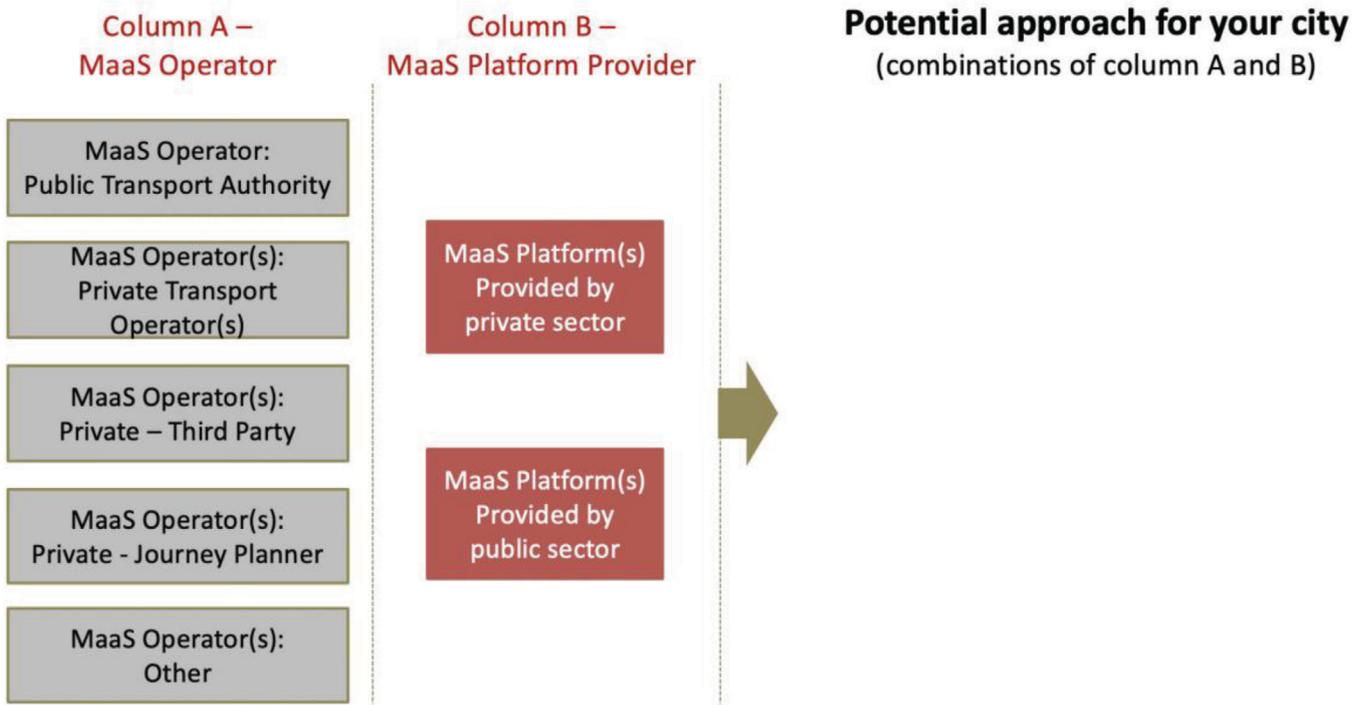


Figure 15 Exercise for practitioners: Build a MaaS model for your city (Source: UCL-MaaS Lab)

7. List of references

The authors have used specific reports and papers produced through collaborative processes with their members, such as the Report on MaaS of UITP (www.uitp.org) and the series of papers issued by the MaaS Alliance (<https://maas-alliance.eu>). Among the sources used, this guide brings available results coming from lab research (www.maaslab.org) and from ongoing EU-funded MaaS-related projects, such as MaaS4EU (www.maas4eu.eu), MyCorridor (www.mycorridor.eu) and iMove (www.imove-project.eu).

Reference	Deliverable	Source
CIVITAS ECCENTRIC project	Mobility as a Service (MaaS) Readiness Level Indicators for local authorities	https://civitas.eu/tool-inventory/mobility-service-maas-readiness-level-indicators-local-authorities
EMTA	A perspective on MaaS from Europe's Transport Authorities, June 2019	https://www.emta.com/spip.php?article1319
MaaS4EU	D2.1 - State-of-the-art report	www.maas4eu.eu
MaaS4EU	D2.2 - MaaS ecosystem requirements	www.maas4eu.eu
MaaS4EU	D2.4 - MaaS Policy Framework – Initial version	www.maas4eu.eu
MaaS4EU	D3.2 - Legal-Regulatory barriers and Passenger Rights for MaaS – Initial version	www.maas4eu.eu
MaaS Alliance	MaaS Alliance White Paper "Guidelines & Recommendations to create the foundations for a thriving MaaS Ecosystem", 2017	https://maas-alliance.eu/library/
MaaS Alliance	MaaS Alliance Vision Paper on Multimodal Passenger Rights, 2018	https://maas-alliance.eu/library/
MaaS Alliance	MaaS Alliance Vision Paper on Data "Data makes MaaS happen", 2018	https://maas-alliance.eu/library/
MaaS Alliance	Study on the "Main challenges associated with MaaS & Approaches for overcoming them", 2019	https://maas-alliance.eu/library/
POLIS	Mobility as a Service: Implications for Urban and Regional Transport	https://www.polisnetwork.eu/uploads/Modules/PublicDocuments/polis-maas-discussion-paper-2017---final_.pdf
SPICE Project	Best practices and recommendations	http://spice-project.eu
TM2.0, MyCorridor	Laura Cocone, Jaap Vreeswijk, Karl Rehrl, Vassilis Mizaras, Giulia Dovinola, Ruud van den Dries, 2018, "TM2.0 as an enabler of MaaS and its employment in MyCorridor", paper presented at 25th ITS World Congress, Copenhagen, Denmark, 17-21 September 2018	https://programme.itsworldcongress.com/proceedings/login
Trivector	Feasibility study MaaS – A business case for EC2B (2016)	https://en.trivector.se/fileadmin/user_upload/Traffic/Rapporteur/Feasibility_study_EC2B_1.0.pdf

Reference	Deliverable	Source
UCL - MaaS Lab	Kamargianni, M., Matyas, M., Li, W., Muscat, J., Yfantis, L., 2018. The MaaS Dictionary	www.maaslab.org
UCL - MaaS Lab	Kamargianni, M., Matyas, M., Li, W., and Muscat, J. 2018. Londoners' attitudes towards car-ownership and Mobility-as-a-Service: Impact assessment and opportunities that lie ahead. MaaS Lab - UCL Energy Institute Report, Prepared for Transport for London.	www.maaslab.org
UCL - MaaS Lab	Kamargianni, M., and M. Matyas 2017. The Business Ecosystem of Mobility as a Service. Presented at the 96th Transportation Research Board Annual Meeting, Washington DC, 8-12 January 2017.	www.maaslab.org
UCL - MaaS Lab	MaaS Maturity Index	www.maaslab.org/maasindex
UCL - MaaS Lab	Goulding and Kamargianni, 2018. The Mobility as a Service Maturity Index: Preparing Cities for the Mobility as a Service Era. Proceedings of the 7th Transportation Research Arena TRA2018, Vienna, Austria	https://zenodo.org/record/1485002#.X0ahui2Z0u4
UCL - MaaS Lab	Matyas, M. and Kamargianni, M. 2018. The Potential of Mobility as a Service Bundles as a Mobility Management Tool. Transportation	https://doi.org/10.1007/s11116-018-9913-4
UCL - MaaS Lab	Matyas, M. and Kamargianni, M. (2019). Using Mixed Methods to Examine User Preferences for Mobility as a Service Subscription Plans. Paper presented at the 98th Transportation Research Board Annual Meeting	www.maaslab.org
UCL - MaaS Lab	Matyas, M. and Kamargianni, M. 2018. The Potential of Mobility as a Service Bundles as a Mobility Management Tool. Transportation. Online.	www.maaslab.org
UITP	UITP Report Mobility as a Service, April 2019	www.uitp.org
UITP	UITP Policy Brief: Ready for MaaS? - easier mobility for citizens and better data for cities, May 2019	www.uitp.org
VVA	Study on market access and competition issues related to MaaS, June 2019	https://maas-alliance.eu/library

8 Annexes

8.1 MaaS Terminology

It is important to have a consistent terminology when discussing MaaS. For this reason, we refer to the MaaS Lab MaaS Dictionary. Please see the relevant phrases and their definitions in Table 1 below.

Table 1: MaaS Terminology (source: MaaS Lab, MaaS Dictionary)

Term	Definition
MaaS: mobility-as-a-service	Mobility-as-a-Service (MaaS) is a user-centric, intelligent mobility management and distribution system, in which an integrator brings together offerings of multiple mobility service providers, and provides end-users access to them through a digital interface, allowing them to seamlessly plan and pay for mobility.
MaaS Operator (integrator)	The MaaS Operator is the organisation that integrates the mobility service providers' offerings, designs the MaaS Products and sells them to end-users. There could be one or several MaaS Operators in a given area and an operator can provide services across multiple areas.
IT Providers (IT=Information Technologies)	IT providers are the organisations that are responsible for the data and the IT infrastructure. This includes, but is not limited to, payment, ticketing, telecommunications, technical backend, the MaaS platform. The MaaS Operator can also be one of the IT providers.
MaaS Platform	<p>The MaaS Platform is the IT structure that is used by the MaaS Operator to provide the final service of mobility to the end-users.</p> <p>The MaaS Platform is split into two elements: the front-end and the back-end, all of which are made up of components developed by the IT Providers. The Front-End is the customer-facing element. It is the digital interface which is a mobile and/or web application, which customers interact with to purchase and use MaaS Products. The Back-End is the internal support element, enabling the delivery of MaaS. It is a collection of components which perform integral functions such as data import, data storage, journey planning, optimisation, ticketing, payment and communication.</p>
MaaS Platform Provider	The MaaS Platform provider is the company responsible for providing the MaaS Platform. This could be the MaaS Operator or a third party responsible for just the technological elements.
MaaS Digital Interface	The MaaS Digital Interface is a mobile and/or web application, which customers interact with to purchase and use MaaS Products.
Mobility Services	Mobility Services are all of the elements of the system which enable people to travel. This includes, but is not limited to, the transport modes and mobility supportive services. Where, transport modes are the types of services provided to end-users by transport operators (e.g. car-sharing, ride-hailing, taxi, bus, rail, etc.).
Mobility-supportive Services	Mobility-Supportive Services (MSS) are the elements of the physical infrastructure which support mobility services. This includes, but is not limited to, charging stations, fuelling stations, parking spaces.
Mobility Service Providers (MSPs)	Mobility Service Providers are the organisations, be it public or private, which provide mobility services to the MaaS Operator and end-users.

Term	Definition
Multiservice Journey Planner	The Multiservice Journey Planner is a specialised search engine which provides optimal means of travelling from A to B. The planned journeys are optimised for certain criteria important to the end-users (speed, cost, comfort, distance). The Multiservice Journey Planner provides a combination of as many of the modes that can provide the best journey to the end-user.
MaaS Business Ecosystem	MaaS Business Ecosystem is the wider network of organisations that influences how a MaaS Operator creates and captures value.
MaaS Product	The type of service offered by a MaaS Operator to its customers. This includes, but is not limited to, Pay-as-you-go services and MaaS Plans.
MaaS Plan	MaaS Plan is a MaaS Product. The bundled Mobility Services and Mobility-supportive Services that are offered by a MaaS Operator to its customers. The bundle includes the amount of usage, the cost of travel and the duration of subscription.

Mobility as a Service (MaaS) and Sustainable
Urban Mobility Planning