Ecosystem and Business Models of the UMOS-MobilitEU Mobility Service Platform

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1. Executive Summary

This deliverable presents the findings of the detailed analysis of the current state of practice in the MaaS landscape, and their reflection on the UMOS/MobilitEU platform business models and their viability. The deliverable provides input to the strategy of the platform as well as to its development. The main contributor of this report is the Eindhoven University of Technology (TU/e), but all core parties involved in the project provided important contributions at different levels and periods. The design of UMOS business models require as a prerequisite a thorough analysis and understanding of the current landscape of the mobility service and MaaS providers' business and operating models.

In this report, we present a summary of our findings, which are also based on our discussions with UMOS core partners and other ecosystem parties in several meetings. We describe our reflection of these findings on how UMOS business models and relevant revenue channels should be shaped. We believe, the report provides important contributions not only to the UMOS ecosystem - in terms of deriving the decisions for the operations of the platform, but also beyond to the general MaaS arena. The deliverable has direct influences on the commercialisation strategy in terms of depicting how the cost and benefits can be exchanged between parties and what revenue items and channels shall be activated for the UMOS platform.

2. Introduction

The mobility solutions that currently dominate the market in developed countries have raised global challenges [10]. More specifically, privately owned motorised vehicles have been adopted in mass to satisfy our mobility needs [16]. In turn, this has led to urban issues like traffic congestion, air pollution and shortage of parking spaces [78]. These issues are becoming especially troubling in densely populated areas where they reinforce each other. For instance, shortage of parking spaces leads to slow-moving traffic in search of a parking spot and less available space for moving traffic, which causes congestion. In turn, congested traffic is inefficient and causes additional pollution [14]. Additionally, it is expected that urbanisation will increase to two-thirds of the global population by 2050 [74]. Hence, current issues will only become more troublesome with the current approach on mobility [28]. Therefore, new mobility solutions are required to facilitate future transportation [5].

One recent development that is promising in solving the urban mobility issues is the uptake of the sharing economy [61]. The term 'sharing economy' refers to a socio-economic system that exploits resource sharing rather than ownership to achieve business objectives, and thereby it prioritises access over ownership [54]. These sharing principles have found their way into the mobility market as 'shared mobility' [46], which refers to the shared utilisation of mobility resources, thus providing short-term and on-demand access to vehicles without the burdens of their ownership [46].

Some shared mobility services have been around for quite some time and are incumbent in the mobility network. For example, car rental services, taxi services and public transport all offer short-term and on-demand access without ownership. However, the development of advanced information technologies, electronic services and electronic devices have enabled innovative business models to be developed [53]. Bike-sharing, scooter-sharing, carsharing and e-hailing (or ride-hailing) companies have recently emerged, increasing the number of available urban transport modes [46]. These service providers are currently experimenting with new business models and operating modes in a fierce competition for the market [30]. Typically, shared mobility service providers in the market all operate via their own platforms. Consequently, the mobility market has become fragmented, and oversight of the mobility offers is hard to grasp for customers. This issue has led to another innovative concept in the mobility market: Mobility-as-a-Service (MaaS).

MaaS is an emerging strategy to reorganise transport in order to tackle mobility and sustainability challenges [65]. MaaS providers (operators) provide an alternative to traditional mobility solutions, such as car ownership, by enabling travellers to plan, book and pay mobility services of varying transport modes through a digital platform [65]. The main aim of MaaS initiatives is to seamlessly integrate mobility providers of various transport modalities into a single platform and to offer travellers a customisable and optimised mobility service [1, 79]. Therefore, the main value proposition of MaaS platform providers is to offer travellers a seamless, optimised and customised travel experience [8]. The MaaS platform facilitates transactions between the suppliers and customers and exploits platform business model principles [67].

Enabled by the advancements in IT, platform-based business models have emerged in recent years and have been very successful [67]. Governmental bodies are launching MaaS pilots in search of sustainable business models and appropriate governance. For example, seven pilots, all with different set-ups and

learning goals, are running in The Netherlands in the coming years [75]; The European Union has launched a project (MaaS4EU) to accelerate MaaS development and to overcome critical challenges[1].

MaaS ecosystems are often complex [38] and more work should be directed at the links between business models of each stakeholder in the MaaS ecosystem and its organisational forms [48]. Additionally, one of the conclusions of the MaaS4EU project was that developing sustainable business models is one of the key challenges is the proliferation of MaaS [37]. Accordingly, the *main objective of this report* is to clarify the business model landscape of MaaS providers to facilitate the development and viability evaluation of UMOS business models and revenue channels. To achieve this goal, we have performed a thorough analysis of the business models of a diverse set of mobility service providers and MaaS providers (operators) [2]. We looked at the main challenges and opportunities, and accordingly, we reflect on the findings and their implications on the UMOS platform. In total, 17 MaaS providers have been reviewed. Per operator, the integrated transport modes are listed in Table 1. The results show that the scooter-sharing, e-hailing, bike-sharing, carsharing and public transport are distinctively the most integrated modes in MaaS platforms.

Table 1. Integrated transport mode per MaaS provider

MaaS Provider	Scooter-sharing	E-hailing	Ride sharing	Bike sharing	Car sharing	Courier service	Public transport	Alternative Services*
CityMapper		x		x	x		x	
CityTrips	x	x		x	x		x	
EMot	x	x		x	x		x	x
Free Now	x	x			x			
Gaiyo	x			x	x		x	
Jelbi	x	x	x	x	x		x	
Kyyti				x	x		x	
Lyft	x	x		x	x		x	
S'hail	x	x		x	x		x	x
Smou	x	x		x	x		x	x
Turnn	x			x	x		x	
Tranzer	x	x		x			x	
UbiGo		x		x	x		x	
Urbi	x			x	x		x	
Whim	x	x		x	x		x	
WienMobil	x	x		x	x		x	
Zipster	x	x	x	x	x		x	x
Total	15	13	2	16	16	0	16	4

** Alternative services include parking, ferries, and air travel.*

The remainder of this report is structured as follows. Section 3 summarises the findings of the analysis on the business models of the shared-mobility services. In Section 4, we report on the findings of the MaaS business and their implications on the UMOS platform. Section 5 and 6 present the UMOS business model blueprints and revenue channels, respectively. Finally, we conclude in Section 7.

[1] *MaaS4EU -- End-to-end approach for mobility-as-a-service tools, business models, enabling framework and evidence for European seamless mobility. Retrieved 25-05-2021, from http://www.maas4eu.eu/*

[2] *Full version of the report entitled: "A Review of Business Models for Shared Mobility and Mobility-as-a-Service (MaaS) is available at: https://drive.google.com/file/d/1GXOWKp6gYCaxO2f5liSkvsr6Kdl4r69r/*

3. Shared Mobility

Shared mobility services play a central role in MaaS platforms; hence, investigating their business and operating model including their challenges is also important for the UMOS/MobilitEU platform. As the shared mobility market is growing and new operating modes emerge, researchers have classified the current operating modes of shared mobility initiatives. The following main categories of shared mobility modes can be distinguished [46], [62], [55]:

- *Micro-mobility* refers to the services that use vehicles, such as e-scooters, bikes, e-bikes, and e-mopeds, as mobility solutions.
- *On-demand ride services* include recently emerged concepts, such as e-hailing, ridesharing and ride sourcing (including carpooling and vanpooling). However, traditional taxi services are also included in this category.
- *Carsharing* provides on-demand access to cars.
- *Courier network services* refers to the shared use of vehicles for delivery services.
- *Alternative transit services* include -for instance- shuttle and micro-transit services.

Roukouni et al. [55] categorise the impacts of shared mobility modes into six main categories, as displayed in Figure 1. Since many shared mobility concepts have only recently emerged, little research has been published quantifying the impacts of shared mobility. The work by Becker et al. [7] is among the first to assess the welfare impacts of shared mobility and MaaS. The results show that a MaaS scheme with shared mobility allows for *increased system efficiency* in terms of travel *times* and *costs*, while substantially *reducing energy consumption*. Other attempts at quantifying the impacts of shared mobility are specific for single modes.

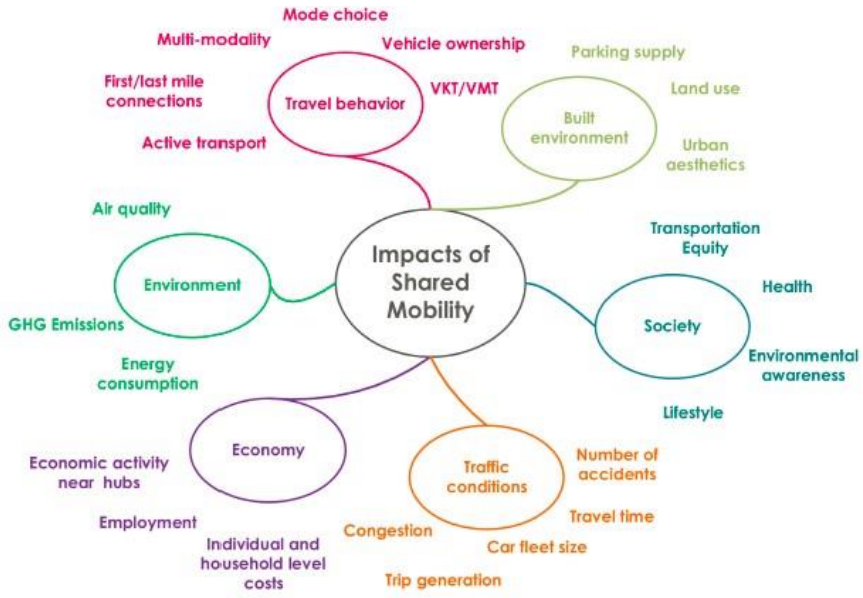

Figure 1. Key areas of impacts of shared mobility [55]

We have performed an analysis of the current operating and business models of shared mobility solutions that interact with MaaS platforms - that is, the bike-sharing, scooter-sharing-, carsharing-, and e-hailing services. The most dominant models for each of these modes are summarised in Table 2.

Table 2. Shared mobility operating/business models

Shared-Mobility Mode	Operating/Business Model	Remarks
Bike-sharing	2WSB, 1WSB, FF, P2P	Large differences across regions
Scooter-sharing	FF	Growing market, still maturing
Carsharing	SB, FF, P2P	Growing market, great potential for achieving societal goals
E-hailing	Private and integrator platform	Traditional taxi service likely to disappear

2WSB: Two-way Station-Based; 1WSB: One-way Station-Based;
FF: Free-Floating; P2P: Peer-to-Peer; SB = station-based;

In the subsections below, we summarise the shared-mobility modes, and common operating/business models that are referred to in practice. *More details regarding these modes are available in a separate report*[3].

3.1. Bike-sharing

Current bike-sharing solutions are characterised by the integration of advanced IT systems and by its integration with other transport modalities [60]. Four main operating modes of modern bike-sharing can be identified: two-way station-based (2WSB), one-way station-based (1WSB), peer-to-peer (P2P) and free-floating (FF) modes. Each mode has its own key features, and the dominant operating model differs across regions around the world. For example, the 2WSB system is mainly operated by public transport providers and serves as a last-mile solution for their public transport network. Alternatively, private companies mainly operate the 1WSB system in Europe, whereas non-profit organisations mainly operate the North American equivalents [51]. While the P2P bike-sharing market is relatively small and focuses on niches [76], the popularity of FF bike-sharing systems has increased significantly over the last few years. Large companies with large investments aiming to capitalise the market are often in charge of FF bike-sharing systems. This mode is growing fast particularly in less regulated regions, such as South-East Asia. Considering the rapid expansion strategies, large investments and low prices, it is assumed that bike-sharing providers are trying to capture as much market share as possible and worry about monetising the business later [40]. The ultimate goal of bike-sharing is to expand and integrate cycling into transportation systems, so that it can become a daily transportation mode [60].

3.2. Scooter-sharing

Scooter-sharing is a relatively new mode of shared mobility, having been introduced in 2012. Hence, its business model has received limited attention so far [3], while its adoption is increasing. Market studies

[3] *"A Review of Business Models for Shared Mobility and Mobility-as-a-Service (MaaS)": https://drive.google.com/file/d/1GXOWKp6gYCaxO2f5liSkvsr6Kdl4r69r/*

show that the number of shared scooters reached 104.000 in 2020 with over 8.7 million users globally [31, 32]. Also, the number of operators is increasing rapidly and this growth is expected to continue [59]. Almost all operators adopt the FF (free-floating) model for shared scooters. Even though the operators offer a similar or identical service, we can notice some trends in the market. For example, operators are experimenting with innovative revenue models and are addressing safety concerns with new measures. Moreover, operators are becoming increasingly multimodal [32]. This trend supports the strategy of scooter-sharing operators to expand rapidly and capture much market share. Because of this strategy, large investments are involved to finance growth while scooter-sharing operators are currently operating under losses [59]. While the market is growing, governmental bodies have recently started to pay more attention on regulating the scooter-sharing services in order to foster the benefits and bypass the pitfalls [59].

3.3. Carsharing

Like bike-sharing, car-sharing has advanced since the mid-20th century, mainly driven by technological developments. Currently, operating modes can be classified into three main categories: station-based (SB), free-floating (FF) and peer-to-peer (P2P) [13, 16, 20, 35, 49, 52]. The SB system is a more advanced version of traditional car rental: cars are scattered around urban areas at designated parking spaces, where customers can pick up and drop off the vehicle. The FF system essentially works the same way, the only difference being that vehicles do not have a designated parking spot but can be parked anywhere within a service area. Unlike the other carsharing systems, the P2P model functions as a two-sided platform at which car owners are suppliers and travellers are customers.

The carsharing market is growing [62], and various actors, such as car manufacturers and traditional car renters, are entering the market. The studies that have researched the potential benefits of carsharing stress the environmental and social benefits deriving from such initiatives [35]. Like bike-sharing and scooter-sharing, carsharing is presumably not a profitable business yet. Carsharing operators are struggling to acquire a customer base large enough to reach the vehicle utilisation rate required to operate at profits [52]. Also, it is a capital-intensive business and operations are complex [52]. To lower the costs of operations, operators are engaging in various strategic partnerships. Examples include partnerships with car manufacturers, local governments, and travellers themselves.

3.4. E-hailing

E-hailing is a taxi service that connects drivers and customers through a mobile application. The introduction of e-haling in 2009 radically disrupted the taxi market [77]. Its platform-based business model allowed for rapid expansion across the world, triggering responses from conventional taxi service operators and regulatory bodies. As issues are being resolved, it is expected that e-hailing will become the dominant mode in the taxi industry [18, 80]. Compared to traditional taxi services, the main competitive advantages of platform based taxi services are: 1) better adaptation to fluctuating demand due to flexible labour, 2) cheaper equipment, 3) faster and cheaper dispatch, and 4) service optimisation with algorithms is more efficient than manual dispatch [15]. Furthermore, two kinds of e-hailing platforms have been active: private platforms that only offer their own services (e.g., Uber), and integration platforms that integrate various taxi service providers into a single platform (e.g., Cabify).

3.5. Takeaway for UMOS/MobilitEU regarding Mobility Service Providers

The margins in shared mobility are under high pressure and there is fierce competition for market share [31, 32], [40], [17], [39]. Hence, service providers of shared mobility seek for establishing long-term relationships with their customers [32]. With the strong urge to protect their customer base, this often leads to hesitations in collaborating with MaaS providers that offer other competing services. Besides market protectionism, the technical challenges are also considerable, particularly in cases where MaaS and service providers deployed proprietary data standards and APIs [19].

UMOS/MobilitEU should put utmost attention to approach mobility service providers with carefully composed value propositions that would ensure that UMOS' objective is to increase customer base without interfering with their current operations and relations with their customers. UMOS's value propositions to mobility service providers are as follows:

- Increased reach (additional exposure to customers),
- Increased attractiveness compared to operating as a single service, and
- Reduced operational complexity and increased economic viability (at higher MaaS maturity stages).

We reflect these further in Section 5 on different operating models and corresponding business model blueprints of UMOS.

4. MaaS Platforms and Implications for UMOS/MobilitEU

In recent years, advances in technology have enabled *platform*-based businesses (also referred to as marketplaces, or digital business ecosystems) to emerge. These companies, such as Airbnb and Uber, connect previously unmatched demand and supply through a digital platform [67]. In addition to platforms, technological progress has also led to an increase in the type of urban travel services, such as bike-sharing, scooter-sharing, carsharing, and e-hailing. This development potentially contributes to more sustainable urban mobility, but also creates complexity for the customer [78]. This fragmentation makes it difficult for travellers to find the optimal offer that best matches their needs.

To address this issue, multimodal *mobility platforms* have emerged. These platforms aim at simplifying offerings, by functioning as marketplaces where customers can purchase integrated multi-modal mobility services from different suppliers. Such platforms are referred to as Mobility-as-a-Service (MaaS) platforms[4]. From a user-oriented perspective, MaaS can be defined as "a digital platform with integrated services, including journey planning involving all modes of transport, booking, e-ticketing, and payment, from the starting location up to the destination" [56]. The main aspects that define MaaS can be summarised as follows [65]:

a) Offering a service with the traveller's needs as the focus,
b) Offering mobility rather than transport, and
c) Offering integration of transport services, information, booking, payment, and ticketing.

4.1. MaaS Maturity Stages

In order to facilitate comparison and evaluation of MaaS, a 5-level topology for MaaS maturity is proposed by Sochor [65], as displayed in Figure 2. At Stage 0, there is no MaaS. In this case, the mobility service providers are providing single, separate services through their own channels. Stage 1 represents the integration of information. Compared to Stage 0, the added value of Stage 1 is that the travellers can use MaaS as a decision support tool for finding the best trip. Since the travellers are typically not prepared to pay for information only, this stage of MaaS has users rather than customers. Mobility service providers contribute by supplying open, standardised data for free. The MaaS provider (operator) is not responsible for the quality of the services about which it provides information.

Figure 2. Five stages of MaaS

[4] *MaaS Alliance -- https://maas-alliance.eu/*

The second stage of MaaS represents the integration of booking and payment. The added value of Stage 2 for the end user is easier access to mobility through a one-stop-shop where the user can find, book, and pay for mobility services with the same app. However, it is not guaranteed that travellers are willing to pay for this service as the alternative, using multiple apps, does not require considerable additional effort (although this effort can be important in certain contexts [45]). Thus, revenue for Stage 2 MaaS providers comes from brokering fees, commissions, or supplier membership fees. Additionally, mobility data might be sold to third parties like local governments for mobility management.

For mobility service providers (transport providers), the main benefit of participating in Stage-2 MaaS is the additional exposure to customers. On the other hand, transport providers are offering their mobility services side-by-side with their competitors. Therefore, it is likely that well-established transport providers will be less interested in participation, as they are less reliant on external channels for their exposure. Stage-2 MaaS providers take responsibility for valid tickets, accurate bookings, and the purchase, but not for the actual travel services. The costs related to integrating these services for many suppliers can be high while margins (from brokering fees or commissions) are likely to be low. Therefore, it could be hard to operate Stage-2 MaaS services as a private business without any support from public authorities.

Stage 3 of MaaS represents the integration of service offers like subscriptions and contracts. For travellers, the main value proposition is an alternative to car ownership that focuses on travellers' complete mobility needs. For transport providers, the main benefit is that they become more attractive for users than they can be as a single service. Stage-3 MaaS providers focus on offering a complete mobility service, which is bundled in some way, that attracts customers with larger mobility budgets and willingness to pay for quality and ease of use. At this stage, the MaaS provider takes responsibility for the service delivered to its customers and for its customers towards the suppliers. Therefore, the MaaS provider must work together with transport providers to run a profitable business. MaaS providers buy capacity from operators which they bundle into service packages. This also migrates risk resulting from uncertain demand towards the MaaS provider. The pricing of individual services is non-transparent. Hence, what travellers pay to the MaaS provider is not directly linked to what the operator pays to the supplier. Additionally, pricing models of transport providers towards MaaS providers can be different from what the transport operators promote to their own customers. Hence, MaaS providers that are skilled at negotiation and understanding customer needs could achieve higher average margins.

Finally, Stage 4 represents the integration of societal goals. The main benefits of the 4th stage are similar to the societal benefits of single shared mobility modes: reduced transportation costs, reduced car ownership, less congestion, and more efficient usage of resources. Public authorities can create incentives for desired behaviour by setting conditions for MaaS providers. For example, pricing of various modes could be adjusted such that more sustainable transport modes become more attractive. Some MaaS providers like Jelbi promote sustainable movement as the primary value proposition by adding incentives and gamifying the experience [34]. The value propositions of MaaS providers, as presented in this section, are summarised in Table 3 for travellers and mobility providers.

Table 3. Value propositions of MaaS

Stage	Traveler	Mobility Service Provider
Stage 0	-	-
Stage 1	Decision support	Additional exposure
Stage 2	Decision support + convenience	Additional exposure
Stage 3	Complete mobility solution	Increased attractiveness + less uncertainty
Stage 4	Complete mobility solution + societal goals	Increased attractiveness + less uncertainty

The interest in MaaS has spread quickly, mostly across Europe, along with the rapid advances in information and communications technology and the internet of things (IoT) [56]. In addition to the advances in IT, another reason behind the rapid advance of MaaS in Europe is that the European Commission has continually promoted multi-modal journey planners across the EU for more than a decade. This is because the realization of Stage-4 MaaS solutions is consistent with the policy directions of the EU member states promoting the use of public transport and other more sustainable ways of transportation [56]. Despite the enthusiasm of governments and companies in the sector, MaaS providers are struggling to successfully launch their services [19]. They face difficulties in:

1. aggregating several mobility services,
2. standardising data and interfaces,
3. offering a real-time service, and
4. finding a viable business model.

The outcomes of research commissioned by the EU suggest that finding an appropriate business model is the biggest obstacle in the implementation of MaaS, compared to technology, end-user and policy-related difficulties [37].

Takeaway for UMOS/MobilitEU

We consider that it is important to address the peculiarities of multiple MaaS maturity stages to cater for the need of multiple types of mobility service providers. Hence, we propose 3 operating modes associated with stages from 2 to 4 (as reflected in Section 5.1).

4.2. MaaS Ecosystem and UMOS/MobilitEU

Only limited information - both in research and practice- is available on the business models of MaaS solutions [58]. The research on the business models of 15 active multimodal mobility platforms in the online application marketplaces of iOS App Store and Google Play Store identified the following value propositions: *increased coverage of transport modes* due to multimodality, *increased convenience* , and potential to *exploit mobility data* [78]. Additionally, new opportunities to generate revenue arise by acting as a *data broker*.

Another value proposition of MaaS platforms that is investigated in more detail relates to the *environmental concerns* [58]. MaaS can generate sustainability related value to:

1) customers, through attractive, cost-effective, and convenient mobility services,
2) the environment, via reduced emissions, and
3) society, which benefits from lower congestion and improved accessibility.

The MaaS ecosystem can feature 3 layers around the MaaS provider/operator, as presented in Figure 3 [38]. The core layer includes customers/users, the transport operators (mobility service providers), and data providers. Below we provide a discussion of these ecosystem parties.

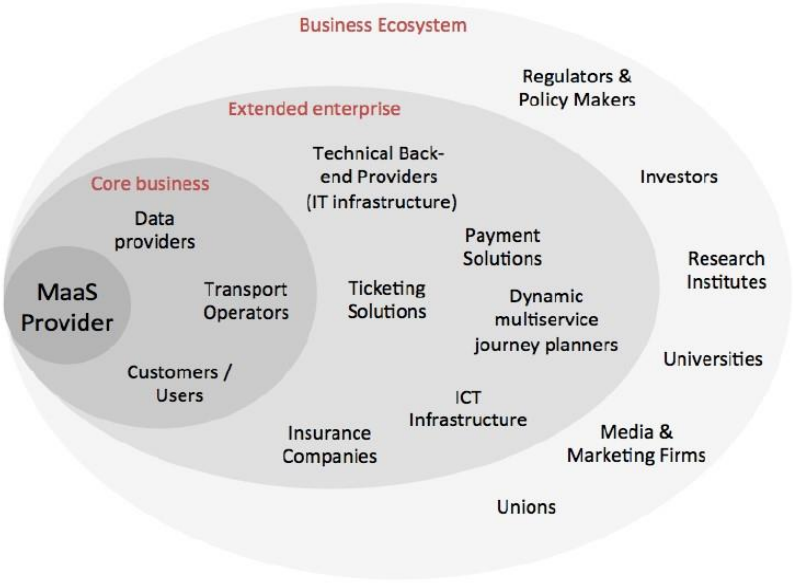

Figure 3. MaaS ecosystem [38]

MaaS Provider (or Operator): At the centre of the ecosystem, also the main orchestrator in the business model, is the MaaS provider or operator. In practice, we can distinguish 3 types of MaaS providers [18]:

- Commercial (private) operators,
- Public operators, and
- Public-private partnerships.

Furthermore, two types of MaaS providers can be distinguished from the point of view of their operation: *resellers* and *integrators*. The main activity of a resellers is to solely provide a platform at which mobility providers can offer their services to the customers. Such operators are typically offering Stage-2 MaaS solutions, as they do not offer additional services other than functioning as a marketplace for mobility. On the other hand, integrators bundle services from different providers and offer the trip as a single product to the customer, usually as an extension of its own mobility service. Examples of such services include Whim[5], run by a private company and UbiGo[6], run by a public organisation. These services can be

[5] *Whim. (2021) Experience the seamless way to move around. Retrieved 09-11-2021, from https://whimapp.com/helsinki/en/*
[6] *UbiGo. (2021). Mobility services for you and your family's journeys, every day. Retrieved 11-09-2021, from https://www.ubigo.me/en/home*

considered to be at Stage-3, as they combine multiple modes of transport and offer additional services, such as customised subscriptions [56].

Public MaaS providers are often public transport operators which aim to extend their offerings by integrating other transport services. These additional services are typically last-mile transport solutions, such as bike-sharing. Other public operators are local governments like the municipality of Barcelona, Spain, which operates SMOU[7]. The public-private partnerships are similar to publicly operated modes. An example of such a partnership is the CityTrips[8] in Spain operated by RACC.

Traveller: Travellers are the main customers who benefit from the value delivered by MaaS and are core business partners of MaaS providers. The perceived value of MaaS depends on the stage in which it operates. At Stage 1 and 2, the value offered is relatively limited, as the MaaS provider offers only ease of use, i.e., a better travel experience. The value propositions of Stages 3 and 4 MaaS solutions are relatively advanced for travellers as they offer a complete mobility solution. Stage 4 also delivers an optimised trip to achieve societal goals. Travellers pay a service fee for this service, either on pay-as-you-go basis or via subscriptions. Additionally, travellers provide data for the network, such as their account data, mobility data and reviews, which provides trust in the network.

Mobility (service) provider: Other core business partners of MaaS providers are the *mobility (service) providers*. They act as suppliers of mobility in the platform business of MaaS providers. While most research focuses on the customers (travellers), the value proposition for the suppliers should also be considered as MSPs benefit from a larger customer base and better customer targeting abilities [78]. Again, the benefits for mobility providers depend on the stage that the MaaS solution is in. At Stage 1 and 2, mobility providers solely benefit from increased reach, and therefore possibly increased revenue. At Stage 3 and 4, mobility providers become more attractive as they contribute to a complete mobility solution that can replace traditional mobility solutions, such as car ownership. In an advanced stage of MaaS platforms, the transport providers (mobility service providers) can even drop their own digital platform and rely solely on the MaaS platform as its sales channel, which would significantly reduce the complexity and costs associated with their operations. This also facilitates the market entry of small mobility providers as the development costs of required infrastructure would be reduced significantly.

Governmental bodies (cities, road authorities, etc.): As mentioned, MaaS has the potential to solve urban mobility issues. Evidently, this aligns with the interests of governments and public bodies around the world. Therefore, public actors are actively developing and offering MaaS solutions while there are also private actors trying to capitalise on the market. In any case, municipalities and cities that are exploiting MaaS platforms must ensure that they are accessible and inclusive by involving all the focal stakeholders - from the operators to the citizens-, to avoid a situation where MaaS services only address the most profitable part of the market [1]. Only if MaaS services are inclusive and well-regulated, MaaS can achieve Stage 4 and serve for societal goals.

Traffic authorities: As for all platform-based business models, the platform provider (MaaS provider), customers (travellers) and the suppliers (mobility providers) are important actors. The data provider role

[7] Smou. (2021). Smou. move easily. move better. Retrieved 10-11-2021, from https://www.smou.cat/en
[8] MaaS Alliance. (2021). Maas of the month: Citytrips - the leading MaaS aggregator in Spain. Retrieved 10-11-2021, from https://maas-alliance.eu/wp-content/uploads/sites/9/2019/09/MaaS-of-the-Month-RACC_FINAL-1.pdf and https://gocitytrips.com

may as well be considered a business partner in the MaaS ecosystem under certain conditions, as MaaS relies heavily on interoperable data availability [38]. The data provider is a third party that collects and processes the data of the transport operators and a range of other sources, like travellers' phones and social media. However, the desk study on MaaS providers revealed that establishing partnerships with mobility operators and collecting their data is often one of the main activities of MaaS providers. Therefore, the data providers are often not a separate actor in the MaaS business model. Another actor that is considered an important enriching partner in the business model is the traffic authority. Traffic authorities can share real-time traffic data to facilitate the optimisation of routes. Additionally, traffic authorities could play a role in validating customer data, such as driver licenses. Reversely, traffic authorities could use the data from MaaS providers to optimise their policies.

Financial institution: Transactions should be handled in a fast and secure way to establish trust in the system. Therefore, a reliable financial institution is important in the business model. Such institutions generally ask for a transaction fee for each transaction or gain revenue via negotiated contracts.

Takeaway for UMOS/MobilitEU:

Unlike the model in Figure 3, in the UMOS/MobilitEU Ecosystem we emphasise the critical role of governmental bodies (cities, regulators, and policy makers, etc.) and consider them as a core party that contributes significantly to the success of the platform. UMOS collaborates strongly with governmental bodies to help them implement certain mobility policies in their area of control. While generating travel options to users, it will also consider the policies (that can also be dynamically changing based, for instance, on traffic conditions) that are effective on certain regions or districts. It aims to promote or impose only certain modalities for UMOS end-users in specific regions to help support such policies.

4.3. MaaS Deployment Strategy

One of the main questions surrounding MaaS deployment is who is going to be the dominant actor in providing MaaS. Three approaches can be followed [18, 50, 56, 64]:

a) Private-based MaaS, where MaaS is developed and marketed by private/commercial companies,
b) Public-based MaaS, where the city authorities or municipalities set up a MaaS platform to initiate and to stimulate the development of MaaS, and
c) Public-private partnership-based MaaS, where private and public parties aim to jointly develop and deploy MaaS.

Current deployments predominantly follow the first 2 approaches [5]. Below, we further explain these deployment approaches.

Private-based (market-driven) MaaS

In the first scenario, private/commercial companies lead the development of MaaS. In the mobility domain, companies like Uber notice an opportunity to open new markets. Shared mobility providers, such as Bird, are becoming increasingly multimodal to capture greater value by delivering more extensive services.

Besides expanding their own operations, the companies are also seeking partnerships with other providers to quickly expand the offerings. To achieve such deals, transport operators will need to:

1) make it possible for third-party actors to resell public transport tickets digitally [41],
2) modify the range of PT tickets in order to facilitate bundling with other transport modes [29], and
3) offer viable and fair deals for third-party resellers.

The MaaS provider solely acts as a reseller in this scenario, as the other transport modalities are extensions of its own services.

Alternatively, some parties are launching services that fully focus on delivering on MaaS as integrator, instead of extending their mobility services (e.g., Meep). This is also enabled by cities, such as Lisbon, which have not (yet) involved in a government-supported initiative. To successfully run such businesses, MaaS providers also need to reach agreements with many transport providers. Additionally, a large critical mass needs to be reached for integrators to be efficient and profitable.

The scenario where the deployment of MaaS is private-based and market-driven, is largely based on the argument that private sector actors have higher incentives and better capabilities to develop innovative services that meet customers' needs, compared to the public sector [64]. While private companies are often efficient in finding suitable solutions and business models, participation of the private sector within MaaS could also be a reason for concern. Private companies do not always oblige themselves to provide the services at all times. Hence, they may opt for cancelling services to some urban areas if they are not profitable. MaaS needs to assure its customers that it can cover a broad scale of urban areas to be relevant for users and comply with societal goals.

Public-based MaaS

Besides private companies being eager to expand their mobility services, there is also much interest in MaaS from the public sector. For example, German local transport providers, such as BVG in Berlin, are deploying MaaS platform solutions [5]. Likewise, the EU has commissioned large scale pilot projects to develop the initial version of prototype business models for MaaS [37]. The interest from public actors is unsurprising, since MaaS aids the transition to more sustainable city transport modes. For instance, MaaS could reduce congestion by making more users switch to public transport or shared mobility services. It may even alleviate the need for car ownership, which implies less demand for parking spaces [33]. Another driver of public interest in MaaS is that it may have a direct positive impact on pollution levels of urban areas and an indirect impact on climate change and the energy transition.

Besides the potential benefits of MaaS itself, public actors aim to ensure its *societal value* is achieved. As mentioned, private actors may choose not to serve certain areas if these are not profitable. Additionally, many people argue that the benefits related to reduced car usage are only achieved if MaaS puts public transport at its core. Private MaaS could promote more profitable modes, such as carsharing, which may increase car use in urban areas and cause more congestion and pollution. Therefore, it is important that authorities try to steer the development of MaaS towards more public-transport-based solutions. Moreover, this gives cities the opportunity to utilise their current transportation network more efficiently. Another benefit of MaaS for public actors is that it could fully integrate subsidised transportation (e.g., school transportation) and social service transportation (e.g., for the elderly or disabled). Managing and planning such services via MaaS platforms could significantly cut costs for municipalities.

However, public-controlled development of MaaS might also create some barriers. While public transport operators have a lot of infrastructure in place, public organisations are often rigid and respond slowly to change. For example, in The Netherlands, it takes 6 to 9 months for a new company to be brought on to the OV-Chipkaart system (the payment and ticketing system for public transportation) at considerable costs [5]. Such inflexibility creates a large barrier for innovative mobility providers to join the MaaS platform. In addition, the critiques of this approach argue that a system led by public actors is biased towards over-favouring public transport and thus not providing a strong cognitive bridge for "car-lovers". Hence, they propose that a strong carsharing offer should be paired with robust public transport to "convince" car-prone people to stop owning a car as a first step in their transition towards sustainable multimodality.

Public-private partnership MaaS

The third option involves a variety of partnership possibilities between public and private parties. This may include mixed consortiums that tender the services, or private initiatives launched in close collaboration with the public sector. In the latter, the public sector enlarges its scope in the personal transport service value chain by absorbing the MaaS integrator role, while the MaaS provider role remains open for private actors. In practice, the public sector contributes to the development of the integration platform, which results in lower investment costs and easier market entrance for MaaS providers, as they do not have to develop an integration platform. Activities like bundling services, negotiating contracts and provide customer service would be the responsibility of the MaaS provider. An example can be found in Japan where the authorities have developed an integration platform to facilitate MaaS, called MaaS Japan[9].

Yet, this scenario is not free of challenges. The first difficulty relates to the fact that public and private actors often have conflicting goals. Without any additional regulation, private companies are not bound to serve societal goals. For instance, private MaaS providers could aim to maximise their profits by selling as many and as expensive trips as possible. In contrast, the public sector strives to reduce the amount of travel and to increase the modal share of public transportation, which is an inexpensive product compared to -for example- carsharing [64].

Table 4 summarises the pros and cons for the three strategies of MaaS deployment.

Table 4. Strategies for MaaS development

Strategy	Pro	Con
Private	Private sector actors have higher incentives and better capabilities to develop innovative services that meet customers' needs, compared to the public sector	Private companies do not always oblige themselves to provide socially and environmentally sound services
Public	Steer the development of MaaS towards the achievement of societal goals (centred around public transport)	Public organisations are often rigid and slow in responding to change (OV-card example). Such inflexibility creates a large barrier for innovative mobility providers
Public-Private	Use the innovativeness of the private sector while keeping some level of control over the direction of the MaaS development and operation	Conflicting goals of public and private sector (e.g., increasing the share of public transport vs. increasing revenues for private operators)

[9] *MaaS Japan. (2021). Maas Japan - een open data-infrastructuur die de geest beweegt. Retrieved 10-11-2021, from https://www.maasjapan.net/*

Research suggests that the public-private development of MaaS is the scenario with the highest chance of success. In this scenario, the public sector can make use of the agility and innovativeness of the private sector while keeping some level of control over the direction of the MaaS development and operation [64]. Policymakers should take the opportunity to develop an open and public-based MaaS platform [6]. Within this platform, they can prioritise public transport and active modes in highly utilised areas and allow private mobility providers to serve markets that are not covered by public services.

Takeaway for UMOS/MobilitEU

Table 4 summarises the pros and cons for the three approaches for MaaS deployment: public, private, and public-private partnership. As discussed, UMOS/MobilitEU adopts an approach that is aligned and analogous to the public-private partnership strategy. It aims to bring the best of both worlds while balancing the stakes of both public and private parties. Emphasising the role of public authorities in design and operation of the platform is the reflection of this strategic choice. The public sector can make use of the innovativeness of the private sector while keeping some level of control over the direction of the development. Cities can continue their role as policy-makers that prioritise public transport in highly utilized areas and allow private mobility providers to serve markets that are not covered by public services.

4.4. Challenges and Opportunities for UMOS/MobilitEU

In this subsection, we briefly discuss the challenges and opportunities for MaaS platforms in general based on the analysis of the practice and literature, and reflect the findings on the implications for the UMOS/MobilitEU platform.

MaaS platforms are considered two-sided platform businesses. Hence, apart from a number of critical stakeholders (such as those discussed in Section 4.2), they have two major types of customers: travellers and mobility (service) providers. As a result, the challenges and opportunities related to each type of customer should be studied separately. Table 5 summarises challenges and opportunities that MaaS providers must address.

In general, margins in shared mobility are under pressure [40, 59]. Operators are trying to outperform their competitors by reducing their prices [9]. Moreover, low prices are necessary to attract new customers, as they underestimate the costs for conventional transportation modes such as car ownership. For example, Whim offers a subscription service scheme with a premium of $500 per month and has difficulties in attracting customers [56]. This package is equivalent to the cost associated to car ownership, but car owners underestimate the true costs of car ownership by as much as 50% [4]. Hence, customers do not yet perceive MaaS as a cheaper, more efficient solution. This perception is especially troublesome since cost reduction is the best motivator for travellers to start participating in shared mobility, according to survey results [63]. Additionally, MaaS platforms require a high critical mass in order to run a profitable business,

since margins are low [65]. MaaS platform providers will have to overcome these challenges related to travellers.

Additionally, the current state of the market also brings up challenges related to the supply side of the platform, the mobility service providers. As discussed in the sections above, service providers and transport operators of all types are involved in a fierce competition for market share [31]. They aim to establish long-term relationships with their customers [32]. This might withhold a service provider from collaborating with MaaS providers that offer other competing services [31]. Besides market protectionism, the technical challenges are also considerable.

In addition, MaaS providers are already facing technical difficulties in aggregating services of different providers, standardising data and interfaces, and offering a real-time service [19]. The costs associated to the development of technological solutions to address these issues could be considerable [65].

Table 5. Challenges and opportunities for MaaS

	Travellers	Mobility Service Providers
Challenges	1. Critical mass for efficient operations 2. Costs of car ownership underestimated 3. Costs of MaaS perceived as high	1. Protection of customer base and preserving customer intimacy in changing digital environment 2. Margins under pressure 3. Technical challenges 4. Strategic market positioning in changing mobility ecosystem due to MaaS
Opportunities	1. Reduced transportation costs 2. Alternative to car ownership 3. Societal benefits of shared mobility 4. Optimised trips	1. Potential for better margins and/or more customers (also through increased reach to a broader range of travellers) 2. More attractive when combined with other modalities 3. Reduced operating costs 4. Improved competitive positioning compared to car ownership.

On the other hand, there are also many opportunities for future MaaS platforms. As this study shows, the shared mobility market operates with many different business models across various transport modes. Yet, the modes that we analysed have similarities across various dimensions. For example, value propositions of each mode include:

1) mobility improvement,
2) reduced travel costs,
3) improved city liveability, and
4) environmental benefits.

While financial benefits may currently be underestimated by travellers, the potential cost reduction of using shared mobility modes is considerable, especially when adoption rates become higher and operating volumes become larger [55] and MaaS can become a true alternative to car ownership [65]. Additionally,

the societal benefits of shared mobility are evident as they have been stressed throughout this report. In addition, MaaS can potentially offer optimal and customised trips based on individual preferences (as discussed in Section 5.2).

The degree of mobility improvement is an important value proposition for mobility service providers. Already in 2007, researchers considered *convenience* as one of the most important factors for travellers to use shared mobility services [63]. Therefore, systems that offer easier access to mobility (FF and decentralised SB systems) are gaining market share [62]. Additionally, shared mobility operators are becoming increasingly multimodal to extend their value [41]. This trend could be an opportunity for MaaS platforms as shared mobility services become multimodal as they integrate into MaaS networks. The services of mobility providers would then become more attractive for travellers [65], and attract new customers. This would help mobility providers to run their services more efficiently.

Besides acquiring a customer base that is large enough to run efficient shared mobility services, UMOS/MobilitEU could partially contribute to solving the profitability problem through two mechanisms.

- First, if mobility service providers join forces and offer their service via the UMOS platform, they will increase their reach to a broader range of customers with a broadened value proposition. This will potentially increase the utilisation rate of their resources.
- Second, UMOS could potentially negotiate better contracts with enabling service providers, such as financial institutions or insurance companies, due to the larger scale of operations. Offering collective insurance as part of UMOS could be particularly attractive for carsharing operators, as most have difficulties insuring their fleet [63]. The additional margin could then be split between UMOS and the mobility providers.

In an advanced stage of UMOS, the idea of cost reduction for mobility service providers can be extended. For example, the UMOS platform can be extended with further functionalities to support the operations of mobility service providers (e.g., operations of mobility assets, such as bikes and cars) and potentially act as the single customer touchpoint for the services offered by the provider. This would make it possible for the service provider to focus only on the physical assets, and less on the development of their own platform, sales, and customer support channels. This would significantly reduce the complexity of operations and costs for service providers. If competitors agree to offer their services in a common platform, it can provide a mutual benefit. In essence, this scenario could be compared to the current situation for e-hailing providers. E-hailing providers reduced the cost of entering the taxi market for small-scale service providers by developing the infrastructure through which taxi drivers can offer their services. Consequently, the costs of market entry have been reduced significantly as taxi drivers do not need to invest -for example- on a taxi meter, a rooftop sign, and a dispatch infrastructure. Similarly, the UMOS platform could provide the sales channel and complementary services such that mobility service providers can focus on their core business: operating an efficient mobility service.

5. UMOS/MobilitEU Business Model Blueprints

During the first year of the UMOS project (2020), we reported the initial versions of the UMOS business model blueprints and operating modes in a concept design document [70]. In this report, we provide their updated versions, that reflect the developments in the second year of the project, the strategic consideration of UMOS (as reported in Deliverable 4.1) and based on our detailed analysis of current market conditions that are described in the sections above (and as a separate document[10]).

5.1. Operating Modes

UMOS/MobilitEU aims to operate through 3 concurrent *operating modes* to cater for the needs of mobility service providers of different size and characteristics. These operating modes are aligned with the maturity stages of MaaS development, as discussed in Section 4.1. These modes correspond to the 2nd, 3rd, and 4th stages of the MaaS maturity stages (Figure 2).

In *Mode A*, UMOS acts as an open service platform that mobility and other service providers connect - through APIs- to access the services of other providers and to integrate them into their offerings to enhance their value propositions to their customers. In this mode, UMOS is an invisible layer to the traveller but helps lifting the barriers between service providers.

In *Mode B*, the traveller can access UMOS's planner, which is in the form of a mobile/web application to plan his/her travel end-to-end. Enabled by the platform operating in Mode A, UMOS offers optimised and customised mobility information for the traveller as its value proposition in Mode B. The travel planner application provides alternative travel options and once the selection is made, it directs the traveller to the selected service providers' applications (touchpoints) to obtain tickets.

Mode C takes a step further than Mode B and takes over the ticketing functionality to become the one-stop shop for the travel experience to offer seamless mobility. In this mode, UMOS also allows service providers to use the platform as their single point of contact with their customers. This is particularly important to lower entry barriers for new service providers in the domain, as it lowers the investment and (potentially) operational cost of the technology infrastructure.

By offering three operating modes, UMOS aims to balance the concerns of service providers and the needs and expectations of travellers. Considering the diverse characteristics and strategic concerns of mobility service providers, UMOS aims to offer different value propositions with respect to the level of visibility that a service provider would like to keep in front of its customers (as discussed in Section 3.5). While large and established providers may opt for Mode A or Mode B and benefit from providing enhanced mobility services to their customers, Mode C would be attractive for small and medium-sized service providers, which would prefer to focus on their core capabilities (offering mobility and relevant services) and rely on a continuously maintained UMOS/MobilitEU platform to act as their interface to all European travellers, thereby increasing their reach.

[10] *"A Review of Business Models for Shared Mobility and Mobility-as-a-Service (MaaS): https://drive.google.com/file/d/1GXOWKp6gYCaxO2f5liSkvsr6Kdl4r69r/*

5.2. Business Model Blueprints

Aligned with each operating mode, we have developed a business model (BM) blueprint using the SDBM/R (Service-Dominant Business Model Radar) method [26, 44, 71, 72]. An SDBM/R depicts how a network of organisations aims to co-create value for and with the customer [2, 25, 57, 68] . The mobility domain is suitable to use this representation [12, 43, 69], as service solutions in this domain inherently require close collaboration of multiple stakeholders each with specific expectations regarding the costs and benefits, and individual value proposition [11, 23, 42, 69, 73]. SDBM/R provides a simple yet effective way to represent such collaborations in the form of business model blueprints [21, 22, 24, 27, 66]. We present below the business model blueprints for each UMOS operating mode.

Blueprint for Operating Mode A

As described in Section 5.1, in Mode A, UMOS/MobilitEU's core architectural element is the service platform, which allows mobility and other service providers to connect through APIs to access the services of other providers and to integrate them into their offerings. Figure 4 depicts the business model blueprint for UMOS Mode A. The value proposition of UMOS in this mode is the *enhanced service provisioning for service providers*. Accordingly, the main *customer* of UMOS in this mode are the *mobility service providers*.

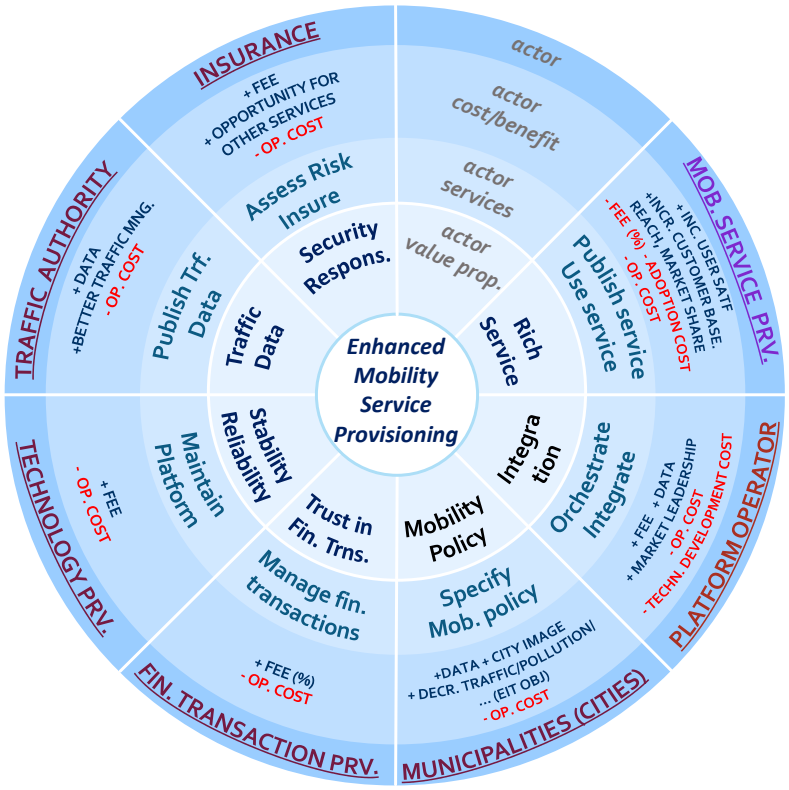

Figure 4. UMOS/MobilitEU BM Blueprint for Operating Mode A

At this stage (Stage 2 of the maturity grid), UMOS operates in the background and allows MSPs to connect to the platform to publish their services and integrate services of other providers into their offering to enhance the value of the mobility services they offer to their customers. Enhancing service provisioning is supported also by the fact that, from the service provider's perspective, the attractiveness of its service is increased compared to operating as a single service (as discussed in Section 3.5).

As the *platform operator*, UMOS is the focal organisation that offers the APIs for the platform to allow for the publishing of services offered by the providers and for keeping them up to date.

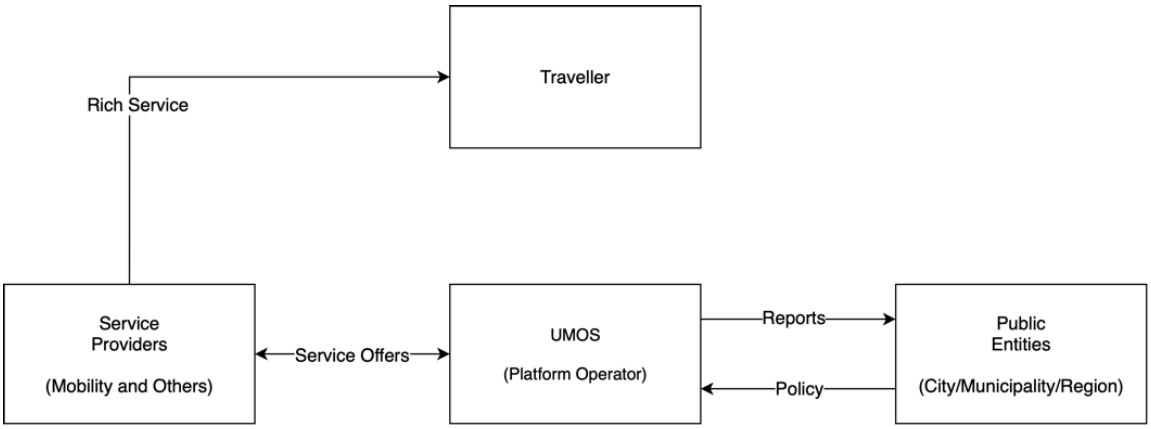

Figure 5. Actor Interactions in Mode A

Business Model Blueprint for Operating Mode B

In Mode B, UMOS/MobilitEU is accessible to the end-user through a *mobile/web application* and offers *optimised and customised mobility information for the traveller* as its value proposition. In this mode, the traveller is UMOS' end-user and, therefore, its direct customer. Figure 6 depicts the business model radar for Mode B.

Mode B relies on the platform that is running already in Mode A. That is, mobility and other service providers are expected to offer their services through the platform and to update these services such that real-time or up-to-date information can be displayed to the traveller. As depicted in the blueprint, service providers (including, for instance, insurance providers) are asked to pay a fee for their presence on the platform, balanced by the benefit of a potential increased customer base (and as such, increased revenue). This fee can be per transaction, per time or per number of customers, dependent on the revenue model.

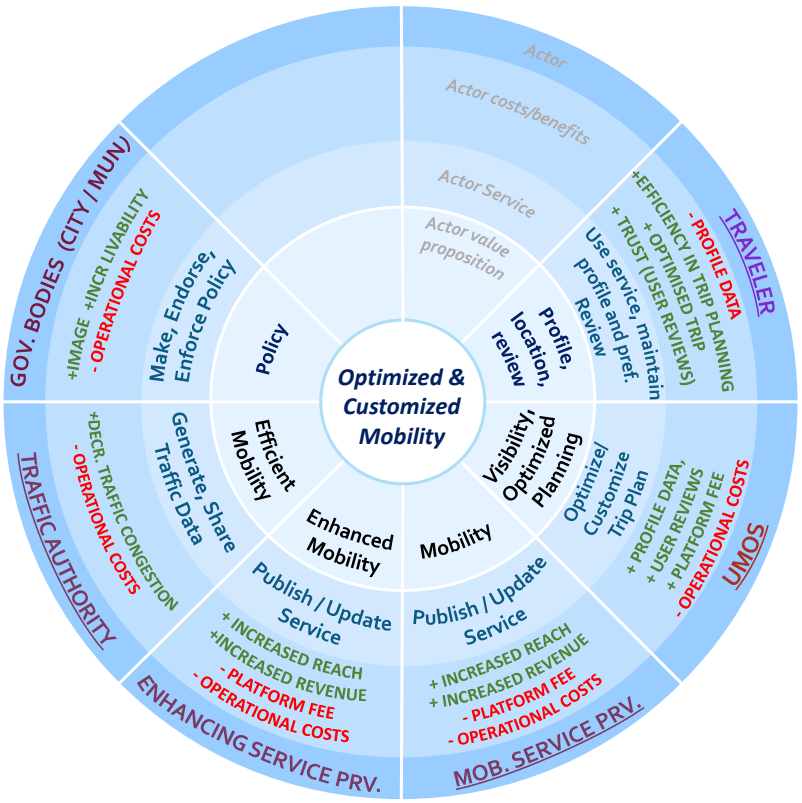

Figure 6. UMOS/MobilitEU BM Blueprint for Operating Mode B

The mobile/web application acts a travel planner which connects to the service platform, retrieves suitable services, and offers an array of travel options as a response to the user's trip specifications. These options are optimised based on the real-time traffic information, and customised based on the traveller's past trips, profile data and other preferences. (These may include, for instance, priorities on journey time, cost, comfort, or CO2 emissions, or preferences regarding modal choice, or user satisfaction scores of service providers.) Where applicable, the options are complemented by enhancing services. In case multiple alternatives are available, the traveller has the option to select the service provider that he/she prefers (also based on existing user ratings). The trip can moreover be insured if needed through the set of insurance providers that participate in UMOS.

Once the traveller makes the selection, he/she is re-directed to complete the transactions (ticketing, etc.) through the platforms of the service providers that are involved in the selected option. This enables service providers to keep their customer touchpoints, while enjoying increased visibility and reach through UMOS, thereby increasing their revenue.

Governmental institutions (cities, municipalities, etc.) are present in the model to ensure that traffic and mobility policies are enforced or stimulated. This may vary from managing the set of mobility service providers that can act in UMOS in a certain city or to stimulate mobility service providers that adhere to rules and regulations through UMOS.

Figure 7 presents the stakeholders involved in this scenario and their interaction with the traveller. In this scenario, the traveller benefits from increased efficiency in trip planning. Acting as the starting point for the traveller, UMOS learns from past travels and user preferences and reviews, and continuously improves its recommendations.

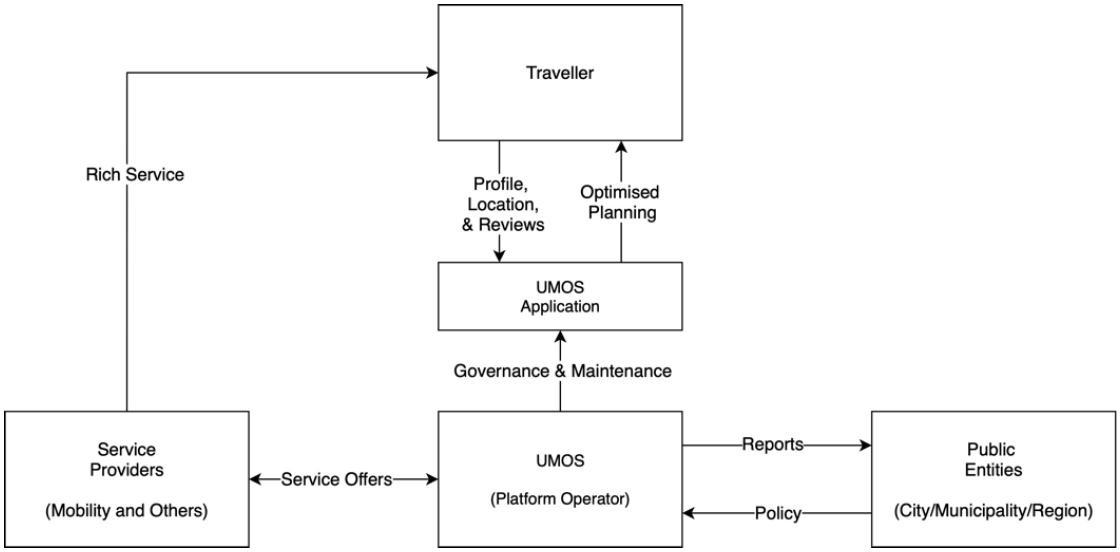

Figure 7. Stakeholder Interactions in Mode B

Although Mode B relies on Mode A, it corresponds to Stage 1 of the maturity grid, acting as the integrator of information from various sources.

Business Model Blueprint for Operating Mode C

Mode C builds upon Mode B and realises the ultimate UMOS/MobilitEU vision of becoming the one-stop shop for the travel experience, offering not only *optimised and customised*, but also *seamless* mobility. In this mode, UMOS enables also the *ticketing and related transactions* to be performed directly through its platform, orchestrating the data exchange between service providers for end-to-end travel. In that respect, this model corresponds to Stage 3/4 of the MaaS maturity grid.

The blueprint for Mode C, including the stakeholders involved, is presented in Figure 8. As it can be seen, the blueprint is very similar in terms of structure and stakeholders, while the cost-benefit structure and the underlying scenario differs significantly.

In this blueprint, and unlike the scenario for Mode B, the traveller pays once for a single ticket for all services involved. The financial transactions taking place in the background between UMOS and service providers are secured by the financial transaction provider, and potentially insured by the insurance provider.

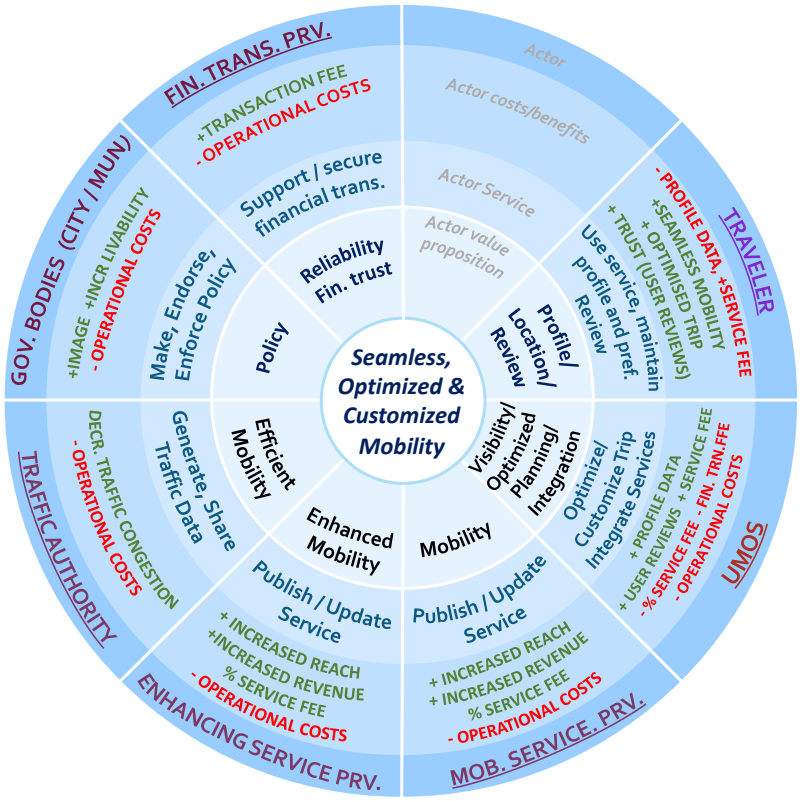

Figure 8. UMOS/MobilitEU BM Blueprint for Operating Mode C

The stakeholders involved are presented in Figure 9. As it can be seen, in this mode, UMOS is the only traveller-facing party during the travel planning and purchasing stages. Service providers will be facing the traveller during operation/service provisioning stage; however, the traveller is not necessarily informed about the exact service provider and may contact the provider only through UMOS.

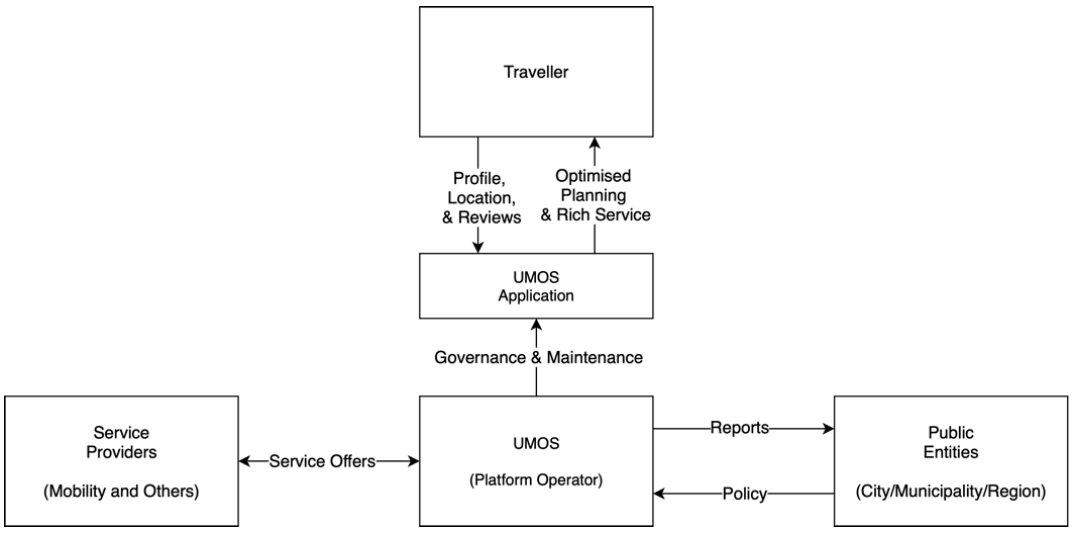

Figure 9. Stakeholder Interactions in Mode C

6. Revenue Channels and Viability

Although activities in this field are ongoing, at present there are no established frameworks and quantifiable evidence about MaaS costs and benefits [36]. Despite the limited availability of literature and examples of MaaS providers, a few different revenue models can be distinguished.

First, the *reseller model* relies on commissions over transactions (pay-as-you-go) as its main revenue source. Margins are likely low since resellers only aggregate different modes of transport on a one-stop-shop principle and using multiple apps results in little additional effort for travellers. For instance, Gaiyo in The Netherlands allows the customer to plan their trip in the app and refers to accounts at transport providers' platforms for booking and payment[11]. This approach corresponds to the Operating Mode B of UMOS.

The pay-as-you-go system presents two economic sub-models. Either the MaaS platform negotiates margin sharing with operators to offer an attractive price to users at the expense of the operators' economic balance, which is sometimes already fragile, or the MaaS platform applies its margin directly on the public ticket prices. However, their tickets are then more expensive and thus less attractive for users compared to direct purchase from operators [19]. Hence, we do not consider Mode B as a significant revenue channel.

As opposed to the reseller model, in the *integrator model*, providing a multi-modal MaaS service, is the main business. This corresponds mainly to UMOS Mode C and partially to Mode A. The MaaS provider offers subscriptions to customers and buys capacity from the transport operators which can be used to assemble trips into a single package (e.g., Whim and UbiGo). Margins are also low in this model since the services of transport operators are also resold in this model. However, the integrator offers more value to both travellers and suppliers compared to the reseller model.

For the travellers, the integrator MaaS provider delivers a complete service that can replace the need for car ownership. For the suppliers, on the other hand, the MaaS provider migrates risk towards itself by buying capacity according to contracts. Additionally, MaaS providers (in collaboration with cities) could negotiate other aspects, like offering exclusivity for certain routes or parking places in certain urban areas, to become more attractive to mobility providers. The MaaS platform could then increase its margins, or be remunerated through a subscription offered to operators, or through a commission to new customers, or even through a commission on the volume of business generated [19]. In all cases, the MaaS provider collects the service fees from customers and redistributes these revenues among mobility providers.

In addition, at Stage 4, MaaS providers can potentially benefit from subsidies for promoting certain mobility options catered for environmental sustainability. Table 6 summarises the revenue sources of MaaS providers with respect to the stages, and their corresponding UMOS operating modes.

[11] *Gaiyo. — home page. Retrieved 10-11-2021, from https://gaiyo.com/*

Table 6. Revenue sources for MaaS providers

Stage	UMOS/MobilitEU Operating Mode	Revenue Source	Remarks
Stage 0		-	-
Stage 1	Corresponds mostly to UMOS/MobilitEU Mode B	Limited opportunity	Travellers are typically not prepared to pay only for information
Stage 2	Corresponds mostly to UMOS/MobilitEU Mode A	Brokering fees, commissions, supplier membership fees, data exploitation	The costs related to integrating these services for many suppliers can be high while margins are likely to be low
Stage 3	Corresponds mostly to UMOS/MobilitEU Mode C	Traveller membership fees, supplier fees, data exploitation	The pricing of individual services is non-transparent
Stage 4	Corresponds mostly to UMOS/MobilitEU Mode C	Traveller membership fees, supplier fees, data exploitation, subsidies	The pricing of individual services is non-transparent, and pricing of various modes could be adjusted such that more sustainable transport modes become more attractive

The costs incurred by the MaaS providers can be divided into two main categories: operational costs and investment costs. Operational costs include costs related to marketing, legal issues, customer service and support, personnel, platform maintenance and operating fees for partners [53]. The investment costs are mainly related to the platform development, since it is costly to develop a standard and user-friendly platform [5].

As it happens with other platform-based business models, the operational costs increase only slightly if volumes get larger. Therefore, both the reseller and integrator model should operate with large volumes to be profitable. Integrators, such as UMOS Mode C, are even more dependent on volumes to efficiently source the acquired services.

The costs and revenue streams for public and commercial operators are essentially alike. However, the main advantage for public operators over commercial operators is that commercial operators must be profitable to exist, whereas the public operators must deliver only enough societal value relative to the public subsidisation.

In addition to the points discussed above, the following potential revenue sources have been identified for the UMOS/MobilitEU platform:

- *Data exploitation*: The insights that can be gathered from the analysis of MaaS data are relevant to both cities and mobility service providers. For service providers, this can improve the value propositions for their customers and support generating additional revenue. For example, Moovit offers a MaaS solution which includes API and platform development and the company offers urban mobility insights as an additional service [47].
- *UMOS/MobilitEU B2B MaaS:* Many companies offer special mobility options for their employees (e.g., company cars). Targeting these companies to become their primary mobility solution is

another potential direction that can complement the current operating modes of the UMOS platform.

- *Advertisements*: Ads have been an important source of revenue for companies particularly in the digital era. However, sufficient market share is required to capitalise on that.
- *Collaborating with retailers*: We also see MaaS providers establishing partnerships with local retailers to offer discounts for users with the possibility that such discounts (both for retailers and MaaS providers) would eventually lead to increased sales.

Our analysis of the current state of MaaS business confirmed the difficulties that operators face in finding viable business models. Given these challenges, we consider that UMOS should also seek for additional opportunities of revenue sources. Hence, UMOS will consider capturing value through indirect means and by making innovative offerings that leverage the network effects of the UMOS platform. We define the following channels for revenue generation (which are all planned to function in Q4 of 2022 once UMOS builds the relevant capacity to make agreements and operate on a legal basis).

***UMOS/MobilitEU –City Platform services (City Dashboard)*:** UMOS Operating Company will provide consultancy services to the cities for the analysis of mobility needs and for the design and implementation of mobility solutions by leveraging UMOS platform features and connected MSPs. In addition, UMOS City Dashboard product features will be grouped into profiles and will be provided to the cities based on yearly subscriptions. This will include features regarding the performance on and comparison of the shared-mobility services and service providers, effectiveness of policy or recommendations due to specific travel option generation (e.g., on no-parking zone enforcements, 0-emission districts). The cities that participate in UMOS pilot projects will be exempted from such service and product access fees in the context of the pilots. The pilot-participant cities will be able to access UMOS City Dashboard product features free of charge after pilot implementation.

***UMOS/MobilitEU – Mobility Service Providers (MSP) Platform Services*:** UMOS will provide integration, customisation, and configuration services to the mobility service providers in its ecosystem. Shared and paid services, such as traveller authentication and registration of mobility resources (e.g., vehicles, parking lots) can also be provided to support service providers. UMOS will offer a "Mobility Provider Service Catalogue (MPSC)" which is a searchable registry for the MSPs, containing information about their profiles and the mobility services they provide. UMOS MPSC product features will be grouped into profiles and will be provided to the cities on a fee basis. The entry-level MPSC profile will be provided free of charge to all MSPs. In addition, the platform usage plans will be developed for MSPs based on a mix of fixed payment and pay-per-use schemes. The MSPs that participate in UMOS pilot projects will be exempted from such service and product access fees in the context of the pilots.

***UMOS/MobilitEU – Event-based mobility solutions*:** Event organisers need temporal, ad-hoc, yet effective mobility solutions for event participants. UMOS Operating Company will provide mobility solutions by reconfiguring and mobilising resources of UMOS mobility service providers in coordination with UMOS-connected cities.

7. Conclusions

In this report, we present our analysis of the current state of practice in MaaS business, and project our findings on the UMOS/MobilitEU platform. We define business model blueprints for UMOS and potential revenue channels that are considered viable by the UMOS project partners and other stakeholders.

Our thorough analysis of the current state of practice, reported in this deliverable, confirms that finding a viable business/revenue model for MaaS (and shared mobility services) is considered to be a top challenge for MaaS providers. For UMOS, we concur that, while it should do its utmost to activate its revenue channels and capitalise on its services, its short- to mid-term emphasis should be on becoming operational in as many cities as possible with a focus on core-group of users and capturing as much market share as possible. This will help increasing its visibility and span of trust in the broader MaaS network. It can then progress into a state in which it relies less on subsidies and funding.

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