



**UNLOCKING LARGE-SCALE ACCESS TO COMBINED MOBILITY  
THROUGH A EUROPEAN MAAS NETWORK.**

**Deliverable D1.4**  
**Regulatory frameworks for**  
**sustainable business model**  
**innovation and sustainable travel**  
**behaviour**



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# **Deliverable D1.4**

## **Regulatory frameworks for sustainable business model innovation and sustainable travel behaviour**

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## Executive Summary

This report is based on an examination of the business model developments in five European cities that were participants within the IMOVE project. During the project, each city ran a living lab – a quasi-protected space – within which to experiment with Mobility-as-a-Service (MaaS) via numerous pilots and trials of the concept. The five IMOVE living labs (Berlin, Gothenburg, Madrid, Manchester and Turin) operated within diverse political, institutional and cultural contexts, and thus adopted different approaches to MaaS developments. As such, pilots and trials were set up in divergent ways, according to different aims and objectives and targeted different types of travellers. Developments within each living lab also faced a (somewhat) unique set of challenges and obstacles.

This report aims to chart the developments that occurred in each IMOVE living lab by outlining the “approach” adopted within locally adapted MaaS ecosystems, and by mapping business models that were developed within the IMOVE project. The report then examines the set of drivers, motives, barriers and obstacles experienced and faced by practitioners within each living lab – the dynamics of MaaS innovations – as a means to derive implications for the governance of MaaS developments in urban settings. By “governance”, we refer to the actions that can be taken by public *and* private sector organisations to further the MaaS agenda and support innovations that move the passenger transportation system towards a more sustainable, servitised paradigm.

Particular attention is given to the need for changes to existing regulatory frameworks. Broadly, a regulatory framework encompasses multiple types of formal institutions such as laws and legislation, taxation, political directives, goals and targets, and so on. With regard to MaaS, several regulatory arrangements come into play, including political directives within public transportation; levels of taxation for different types of mobility services; parking regulations; open data standards and protocols; subsidies for public transportation; and so on. This report aims to elucidate ways in which regulatory frameworks must be adapted to support MaaS developments.

The findings of this report are applicable to city-level MaaS developments, both with regard to cities at the embryonic stage and those that have already taken the first steps in implementing MaaS, including the five cities that participated within the IMOVE project. The set of regulatory changes outlined within this report can be instituted at different levels of government, although primary attention has been given to European institutions.

## Abbreviations and Acronyms

<b>API</b>	Application Programming Interface
<b>BoB</b>	Biljett och Betal – translated as ‘Tickets and Payments’
<b>B2B</b>	Business to Business
<b>B2C</b>	Business to Consumer
<b>CO2</b>	Carbon Dioxide
<b>ICT</b>	Information Communication Technology
<b>IRIMS</b>	The Institutional Frameworks for Integrated Mobility Services in Future Cities project
<b>LVM</b>	Finland’s Transport Ministry
<b>MaaS</b>	Mobility as a Service
<b>PTA</b>	Public Transport Authority
<b>PTO</b>	Public Transport Operator
<b>R&amp;I</b>	Research and Innovation
<b>WP</b>	Work Package

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## 1 INTRODUCTION

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Mobility is a critical function in cities, regardless of their location. Today, mobility is being shaped by global megatrends like urbanisation, digitalisation, electrification and automation. Together, these trends are making it increasingly difficult and undesirable to travel with single-occupancy vehicles and at the same time open avenues to new forms of passenger transportation. This sets the scene for a large transition in mobility, where Mobility as a Service (MaaS) can play an important role. MaaS integrates information, ticketing, and payment for different modes of transport in such a way that the combined package aims to offer a viable mobility alternative to personal car ownership. IMOVE aims to contribute to this paradigm shift by investigating and validating MaaS solutions in living labs located in five European cities (Berlin, Gothenburg, Madrid, Manchester and Turin).

The transition from traditional, fragmented mobility models towards integrated MaaS services remains uncertain, as there is a limited number of successfully-implemented examples. It remains unclear, for example, whether MaaS schemes will be operated by incumbent service providers with abundant resources and institutional connections, or whether MaaS schemes will be operated by start-up companies that can more flexibly navigate changing social and technical landscapes. MaaS introduces an additional layer of interorganisational complexity to the delivery of transport services. While traditional transportation business models are governed by individual organisations acting in relative isolation, MaaS integrates multiple existing services that are historically managed by independent public and private organisations. Successful implementation therefore depends upon complex agreements among a constellation of organisations, at multiple scales.

This report aims to develop insights and recommendations for the governance of sustainable MaaS systems. In order to fulfil this aim, insights are drawn from IMOVE living labs to outline actions that can be taken by public and private sector organisations to promote MaaS developments in the future. Specifically, the drivers of and barriers to MaaS in the five IMOVE living labs are examined alongside the forces and factors that restrict developments. This analysis of the dynamics of MaaS innovations is motivated by the following questions:

- Why are key stakeholders and transport providers motivated or pressured to develop MaaS solutions?
- What challenges, barriers and obstacles have they faced?
- How have key challenges, barriers and obstacles been addressed?
- What actions are required within the public and private sectors to promote MaaS developments in urban settings?

Within IMOVE, each living lab is situated in a particular political, cultural and economic context, and living lab partners must reconcile a unique set of factors that influence MaaS developments. In this report, these factors are considered through an analytical framework that distinguishes between intra- and inter-organisational drivers and barriers of innovation. Understanding how each living lab has managed these factors can help inform subsequent MaaS initiatives within the five IMOVE host cities, and also provide guidance to other cities with an interest in piloting and trialling MaaS.

## 2 BACKGROUND

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In Europe, transportation is responsible for approximately 25 percent of greenhouse gas emissions, 73 percent of which is attributable to road transportation [1]. In the decade between 2008 and 2017, the number of passenger vehicles per person increased in every European Union member state except Denmark, Lithuania, and Latvia [2]. Automobile dependency in cities has also contributed to deteriorating air quality, and efforts to mitigate air pollution are now required in most major European cities [3]. Given that contemporary cities have evolved over decades – physically and socially – to accommodate single-occupancy motor vehicles, resolving issues related to transportation-related carbon emissions and improving urban air quality will require major reorientations in social and physical structures.

One pathway to addressing these challenges is the development of new mobility services that aim to mitigate the need to privately own and use a car. New mobility services that enable and actively promote more sustainable forms of travel behaviour represent a significant opportunity to assist in resolving ecological problems related to transportation problems while boosting innovation via the development of new business models. Existing business models for transportation broadly fit one of three dominant forms:

- The provision of saleable products such as automobiles and bicycles.
- The provision of pay-per-use services such as car clubs and taxis.
- The provision of public transportation, which typically relies upon a combination of public subsidies and user fees.

MaaS combines elements of the latter two business models by integrating multiple services rather than selling individual products or tickets for individual trips. MaaS takes advantage of product servitisation, in which customers are sold *access* to a service rather than exclusive ownership of a product. Further, MaaS relies upon the integration of previously separate mobility services, as described in existing characterisations of the concept [4][5]. Sochor et al. [6] have developed a MaaS ‘topology’ (Figure 1) which builds on differing degrees of integration. The topology consists of different levels. Level 0 represents the status quo in several cities across the developed world, and is characterised by fragmented mobility services that each compete for customers. Level 1 refers to the integration of information into services (e.g. multimodal travel planners) and level 2 refers to services that facilitate online bookings and payments (e.g. Hannover Mobil). Level 3, which is the current focus of much attention in and around the transport sector, refers to the integration of different mobility services into a single, seamless offering that is made available to users via subscription-based smartphone applications [7][8][9]. Organisations such as MaaS Global (FI) and UbiGo (SE) are active at level 3. Finally, level 4 refers to the integration of societal goals such as transport policy objectives and sustainability targets into MaaS ecosystems and services at levels 0-3.



**Figure 1: The MaaS Topology developed by Sochor et al.[6]**

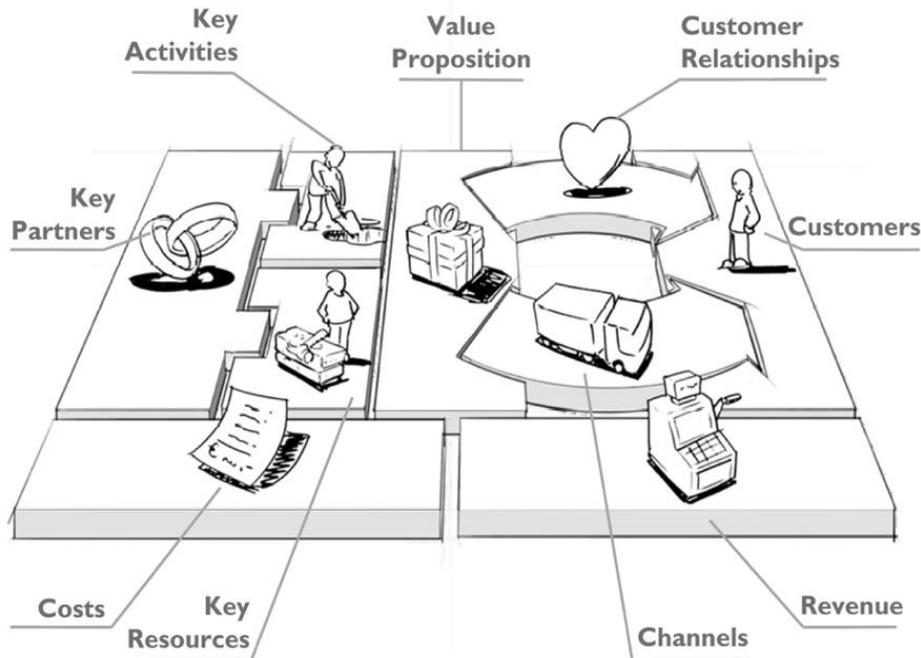
MaaS is a relatively new concept within transportation. Transitioning from a traditional business model based on product exchange (or sales of individual services) to new business models based on sales of access to integrated services involves considerable risks (both perceived and actual) to individual businesses and public-sector transportation service providers.

Within IMOVE, a living lab approach creates an environment for experimentation and observation that mitigates these risks, to some extent. Living labs may be seen as protected spaces wherein organisations are sheltered from some of the selection pressures and market competition of incumbent transportation regimes. Within a living lab setting, pilots are designed to experiment with new business models on a trial basis: individual services are not expected to become fully viable and independently profitable due to the complex nature of MaaS. In some instances, a living lab helps initiatives navigate or circumvent formal rules to allow for experimentation, and temporary incentives may be created to promote uptake. However, other aspects of living labs reflect a real-world context, in that new business models can be tested in the context of real users’ needs and expectations, and in an environment that requires coordination and cooperation among multiple actors. Hence experimentation using living lab methodologies is a useful means to examine the dynamics of MaaS innovations in semi-sheltered yet real-world settings.

## 2.1 MAPPING MAAS BUSINESS MODELS

A business model describes how firms create and capture value, and how they deliver that value to customers [10][11][12][13][14][15]. Business models can also be understood as cognitive instruments that explain linkages between traditional elements of a firm like customers, customer engagement, monetisation, and the value-chain [16]. Changing these different linkages changes the business model. That is, a business model can combine different value propositions, value networks, and cost/revenue models to take advantage of new social, political, and technological landscapes [17].

One traditional way to examine business models is the Osterwalder ontology or ‘canvas’ [12]. While business models are for the most part dynamic entities that are subject to ongoing innovations [14], the Osterwalder canvas can also be used to provide a snapshot of the content and structure of the business model, and the way in which it is governed [15]. In this report, we map relevant elements of the business model canvas for each living lab as a baseline for our analysis of the dynamics (i.e. drivers and barriers) of MaaS developments. The Osterwalder canvas is shown in Figure 2.



**Figure 2: The business model canvas.**

The business model canvas is separated into a customer side (the right-hand side of figure 2) and a delivery side (the left-hand side of Figure 2). The customer side features the service offer and value proposition. It examines who the customers are, how to gain and retain customers, and how the offer is delivered to the customers. The customer side also considers revenue streams. The delivery side of the business model canvas corresponds to production and service delivery. It examines what is required in order to fulfil the customer offer, focusing on key resources, activities and partnerships. This side is also associated with the cost structure of the business model. Entrepreneurs typically develop business models in iterative cycles, consisting of hypotheses generation, testing, and pivoting where necessary. These iterations apply to all elements of the business model.

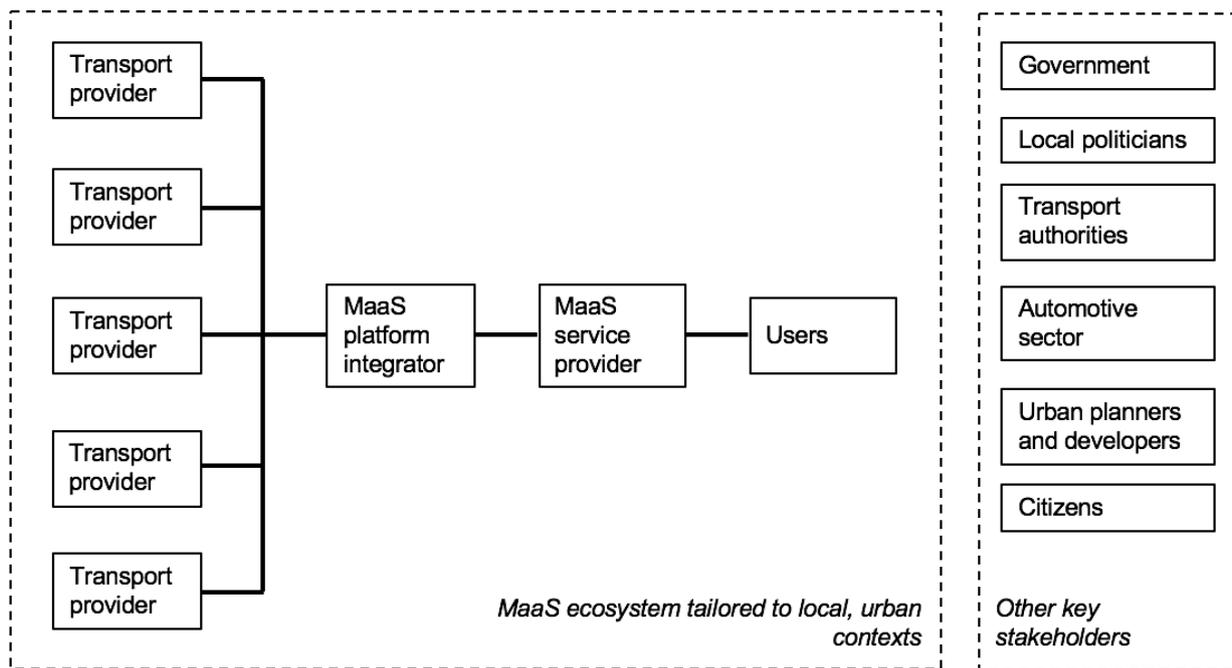
MaaS represents a business model innovation that involves few changes to the physical apparatus associated with passenger transportation. Rather, the business model rests upon the integration of existing transportation modes via a compelling service offer. Several practitioners and scholars have noted the sustainability potential of MaaS, which ultimately rests on its ability to promote more sustainable travel behaviour via modal shifts and shared mobility [6][18][19][20][21].

## 2.2 APPROACHES TO MAAS ACCORDING TO DIFFERENT ECOSYSTEM CONFIGURATIONS

In conjunction with the development of new business models, MaaS developments rest upon new forms of partnerships between actors that do not traditionally interact. Such interactions occur within business ecosystems, which are defined as:

“An economic community supported by a foundation of interacting organisations and individuals—the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies” [22].

A generic MaaS ecosystem is shown in Figure 3. The left-hand side of the ecosystem diagram consists of the MaaS value chain, including different transport services that are integrated into the final service offer. For level 2-3 MaaS services, an ICT platform is required to facilitate bookings, payments and revenue distribution. The service offer is bundled, packaged and delivered to end users via a MaaS service provider. The ecosystem may include other functionalities such as data analytics and ancillary services. The right-hand side of the diagram represents interactions between the value chain and key stakeholders at different geographical scales. Stakeholder interactions are critical in the sense that they can ensure a license to operate (e.g. political directives that mandate third party sales of public transport tickets). In principle, stakeholder interactions are also key to the achievement of societal goals, such as lowered CO2 emissions (e.g. via public subsidies). In other words, stakeholder engagement is likely critical to the achievement of level 4 MaaS.



**Figure 3: The MaaS ecosystem.**

Many of the current barriers to MaaS developments issue from ecosystem dynamics. Currently, one of the most prominent barriers to MaaS developments is the reluctance of functionally separate actors to collaborate in new ecosystem configurations. Existing transport service providers, particularly those who are customer-facing organisations, are disinclined to reposition themselves further upstream in the value chain due to perceptions of business risks. Hence there is an ongoing debate among observers of MaaS about who should take the role as MaaS service provider within the ecosystem.

The living labs within the IMOVE project consist of a divergent set of local characteristics owing to the positions and interests of key actors within the MaaS ecosystem, particularly those of key stakeholders. Consequently, IMOVE represents different approaches to MaaS due to different ecosystem configurations that are observable across the living labs. Within this report, these approaches can be characterised according to three distinct ecosystem models [23]:

1. **A market-driven approach** where commercial MaaS operators adopt the role as MaaS service provider, enabled by public transport operators and other transport service providers who are willing to allow arms-length third-party sales (thus repositioning themselves further upstream in the value chain). A market-driven approach is thought to be more agile and innovative, but limits the influence of public transport on MaaS developments by delegating responsibility for customer interface and

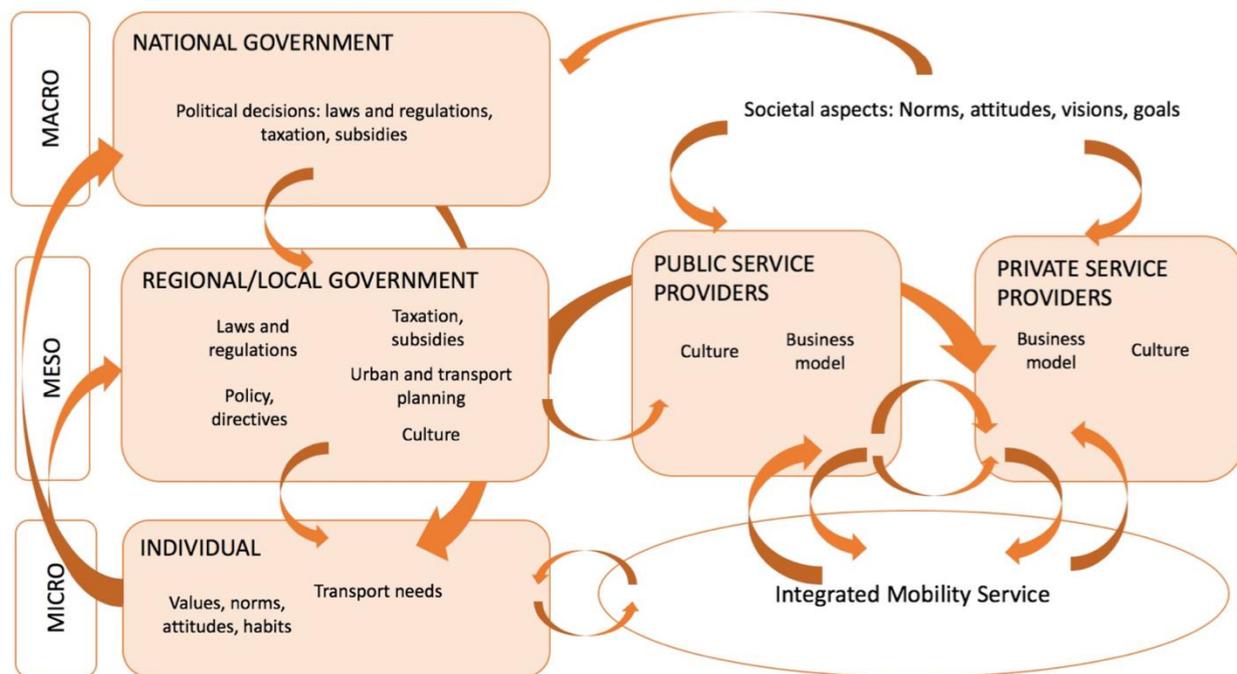
service delivery to commercial MaaS operators, who are more exposed to risks and market pressures than other approaches.

2. **A publicly-controlled approach** where public transport operators either adopt the role as MaaS service provider or procure a commercial partner to adopt this role. This approach is motivated by the need to ensure that MaaS delivers societal goods, to guarantee that public transport acts as a ‘backbone’ to MaaS, and to align potentially divergent interests within the MaaS ecosystem.
3. **A public-private approach** where the public sector adopts the integrator role, allowing public or private actors to adopt the role as MaaS service provider. This approach is thought to lower initial investment costs for MaaS providers as they will not have to develop their own integration platform. The inclusion of a public actor as an integrator is also thought to assist in overcoming conflicts of interests between transport service providers and MaaS providers.

## 2.3 ANALYSING DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS

To examine the dynamics (i.e. drivers and barriers) of MaaS developments in each IMOVE living lab, we utilise a framework developed in the Swedish IRIMS project (Institutional Frameworks for Integrated Mobility Services in Future Cities) [24][25]. The IRIMS framework (Figure 4) draws upon institutional theory to examine the dynamics of MaaS developments at three analytical levels. The macro level includes institutional arrangements that arise at the national and international level; the meso level includes regional and local arrangements (including cities and MaaS ecosystems); and the micro level focuses on individual travellers.

IRIMS deploys traditional definitions of institutions as formal and informal structures. Generally, formal institutions can be understood as regulatory elements such as directives, policies, laws, guidelines and public subsidies. The way in which these elements combine may be described as a regulatory framework. That is, the term regulatory framework refers to any system of laws, regulations, decrees and policies that have been instituted and deployed by governmental bodies acting at different levels (local, provincial, national, regional). Regulatory changes are thus classed as changes to *formal* institutions. By contrast, *informal* institutions include normative (e.g. identities and roles), and cultural-cognitive (e.g. values and traditions) elements. In combination, formal and informal institutional elements provide stability and structure to social life, and generally resist change [26]. As such, existing institutions can pose barriers to MaaS developments, whereas new institutional arrangements can create the conditions to support MaaS developments. For example, [27] describe the differences between Finnish and Swedish approaches to promoting MaaS. Finland’s Transport Ministry (LVM) has very directly promoted MaaS through the adoption of the 2018 Transport Code, which: 1) deregulates public transport and the taxi industry, allowing more competitors to enter the market; and 2) requires that transport service providers open their APIs so that third-party vendors (i.e. MaaS operators) can sell individual one-way public transport tickets to end-users. Finnish developments are also supported by an established network of key organisations operating at multiple scales to fulfil an ambitious vision for MaaS via a market-driven approach. These institutional changes were established with the intention of supporting MaaS developments in Finland, which is arguably one of the pioneers of the MaaS concept.



**Figure 4: The IRIMS framework for examining the dynamics of MaaS developments [28].**

## 2.4 DRIVERS OF MAAS DEVELOPMENTS

Previous research has outlined a broad set of factors that promote and stimulate MaaS developments. These factors can be divided into three categories: global megatrends, innovation opportunities, and potential users, corresponding to the macro-, meso- and micro-levels of the IRIMS framework. In what follows, drivers of MaaS developments noted in existing research [4][9][19][20][25][27][29] as they relate to each of these three levels are listed.

### 2.4.1 MACRO-LEVEL DRIVERS OF MAAS DEVELOPMENTS

Macro-level drivers of MaaS developments include a set of global megatrends — a set of pressures that can be felt acutely within different cities, primarily in the developed world, and which forcefully require changes to existing transportation systems. Megatrends include 1) policy agendas at every level of government to redress climate change; 2) urbanisation and sub-urbanisation, which contribute to congestion, poor air quality, and infrastructure problems; and 3) pressures mobilised via key stakeholders to the transportation system, such as research organisations and different elements of the public sector (e.g. national government committees, provincial and municipal city officials, transport agencies). These stakeholders see MaaS as an opportunity to bring about a sustainable reorientation within passenger transportation, noting that MaaS can boost the economy (via new innovative cycles and job creation), generate environmental sustainability improvements (e.g. reduced emissions and congestion, improved urban air quality, resilience) and contribute to the social aspects of transportation (improved accessibility, social inclusion, affordability). In some European countries such as the Netherlands, Finland, and Sweden, stakeholder interest in MaaS has resulted in ambitious visions and plans, supported by R&I programmes that seek to trial and evaluate the MaaS concept through pilots and assessment frameworks.

## 2.4.2 MESO-LEVEL DRIVERS OF MAAS DEVELOPMENTS

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At the meso level, drivers relate to factors that influence different types of transport providers, among whom MaaS is generally viewed as a significant innovation and business opportunity. The development of new business models that capture the value inherent in collaborative consumption; multi- and intermodal travel; and big data analytics are perceived as a significant innovation opportunity. Further, digitalisation and the application of ICT in the transport sector is seen as an enabler of new service concepts alongside business opportunities linked to the collection and utilisation of real-time data from users, vehicles and other sensor-based technologies. Some meso-level actors also see MaaS as an opportunity to commercialise new vehicle technologies such as autonomous vehicles and electric drivetrains.

## 2.4.3 MICRO-LEVEL DRIVERS OF MAAS DEVELOPMENTS

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At the micro level, which relates to the potential users of MaaS services, the existence of unresolved problems related to everyday travel is a key driver of MaaS developments. For example, a significant proportion of travellers see car ownership as a large financial burden, and congestion and parking are also perceived as motivations to switch from private car usage to MaaS. Some travellers also appear to be motivated to trial or adopt MaaS because they are curious about the MaaS concept, and interested in the convenience, flexibility, and simplicity that it affords. A further driver in this category is linked to the idea that MaaS can enable modal shifts toward more active and environmentally benign transport modes (e.g. public transport, bicycling and walking) – areas in which individual travellers express increasing awareness and interest.

## 2.5 BARRIERS TO MAAS DEVELOPMENTS

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In what follows, barriers to MaaS developments noted in existing research [9][20][25][41] as they relate to each of the three levels or the IRIMS framework are listed.

### 2.5.1 MACRO-LEVEL BARRIERS

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Previous research has outlined the following as macro-level barriers to MaaS developments:

- A lack of political visions for MaaS at the national level
- A lack of engagement from key national players (e.g. industry associations, governmental agencies)
- National transport codes and EU directives that outline definitions of public transportation and prescribe the types of roles that can be taken by public transport operators within MaaS initiatives
- State aid rules and procurement legislation that limits the ways in which public transport can cooperate and partner with private MaaS providers
- Uncertainties regarding the meaning of the above described regulatory arrangements within the public sector
- Varying levels of value-added tax for different types of mobility services, creating an unlevel playing field among service providers.

### 2.5.2 MESO-LEVEL BARRIERS

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Previous research has outlined the following as meso-level barriers to MaaS developments:

- Uncertainties related to roles and mandates within MaaS ecosystems
- Uncertainties related to the business case for MaaS, the business model, overall market demand for MaaS services, and willingness-to-pay for and adopt MaaS among different customer segments
- Perceptions of risks associated with sharing customer data, the loss of control over brands, cannibalisation of existing offers, and the loss of relationships with customers following a repositioning of some mobility service providers in the value chain

- Lack of leadership, knowledge and competence within organisations that can play a key role in facilitating and enabling MaaS developments (e.g. public transportation, municipalities)
- Technological barriers vis-à-vis the absence of digital ticketing and data sharing protocols within public transportation
- A reluctance to allow third-party sales within public transportation and other established mobility service providers (e.g. car clubs)
- Uncertainties related to the (re)distribution of subsidies for public transportation within MaaS ecosystems
- Varying innovation capabilities among different actors within MaaS ecosystems
- Uncertainties regarding the sustainability impacts of MaaS among key organisations within MaaS ecosystems.

### 2.5.3 MICRO-LEVEL BARRIERS

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Previous research has outlined the following as micro-level barriers to MaaS developments:

- A lack of willingness to learn about, change habits and acquire the necessary competence to utilise new mobility concepts
- Perceptions among some travellers that MaaS is not a cost-saving alternative
- An unwillingness among some travellers to adopt services with monthly subscriptions whereby one must pay in advance
- Mismatches between service content (cost, included transport modes, administrative routines, etc.) and actual travel needs
- A lack of flexibility for some travellers without cars and perceptions of feeling 'locked in'.

## 2.6 GOVERNANCE AND THE NEED FOR CHANGES TO REGULATORY FRAMEWORKS

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Based on an understanding of drivers and barriers of MaaS developments, derived from the IMOVE and other relevant R&I projects, this report outlines a set of recommendations for governance – in both the public and private sectors. Private sector governance activities centre on the actions and activities that can be pursued by commercial actors (primarily MaaS service providers) to support MaaS developments. By contrast, public sector governance activities reflect the need for changes to existing regulatory frameworks, again to support MaaS developments. In practice, the nature of MaaS as a phenomenon that encompasses deep public-private collaborations necessitates governance activities within both the public and private sectors as part of a coevolutionary programme of institutional change. That is, examining MaaS developments as a conduit for deriving governance implications has proven (within and beyond IMOVE) a need for proactivity among entrepreneurs and other commercial service developers *and* agencies/organisations at different levels of government to ensure that MaaS develops in a sustainable fashion.

### 3 METHODS

Data for the following sections were collected through a variety of methods. For all living labs, data was collected through semi-structured interviews via telephone and video conference calls with living lab leaders. Interviews lasted between 45 and 90 minutes. The interview protocol is displayed in Table 1.

**Questions**

<p>1. Please give a brief overview of the type of MaaS service offered as part of the IMOVE project in your Living Lab:</p> <ul style="list-style-type: none"> <li>a. Description of the service and the way it is offered (monthly package, pay as you go, etc.)</li> <li>b. Main operator/s and key partners</li> <li>c. Main user segments / types of trips covered</li> <li>d. Geographical coverage</li> <li>e. Etc.</li> </ul>
<p>2. Since the start of the project, how have value propositions developed within your Living Lab? For example, at the start of the project, did you have a clear idea or service concept that could be implemented within the Living Lab? Has the project resulted in any pilots or trials of that concept? How has your knowledge of concepts developed over time?</p>
<p>3. Since the start of the project, how has your knowledge of key customer/users' needs and preferences developed within your Living Lab? Have you targeted key segments, personas and/or types of trips? Have you gathered knowledge on users and their needs?</p>
<p>4. Since the start of the project, have any new customer/user interfaces or channels been developed (e.g. smartphone applications, dedicated websites, telephone services, etc.)</p>
<p>5. Since the start of the project, how have collaborations with key partners developed? Which partners have you been working with? At what stage of development are key partnerships? What barriers to collaboration have arisen and how have you overcome these?</p>
<p>6. Since the start of the project, have any key resources been developed within your Living Lab (e.g. platforms, ticketing solutions and protocols, new mobility services, etc.)</p>
<p>7. What are the main reasons for developing MaaS in your living lab? What are you trying to achieve and why? Do you experience support from local stakeholders? Do directives or legislation exist to support your goals?</p>
<p>8. What challenges have you faced when development MaaS in your living lab? Are there any local stakeholders that oppose your project? Do directives or legislation pose obstacles in any way?</p>

**Table 1: Interview guide used to for semi-structured interviews with living lab leaders**

Within the Gothenburg living lab, action-research was conducted as part of the IMOVE project (and in particular WP1). This work centred on the deployment of the IMOVE Scalability Unlocks, detailed in deliverables D1.1 and D1.2 [46], and included multiple surveys and workshops with living lab practitioners that sought to overcome barriers to ecosystem collaboration. The workshops were defined according to the following format:

1. Each participant was invited to describe a list of drivers and barriers for MaaS developments from the perspective of their own organisation
2. Drivers and barriers were examined according to their underlying rationale and then grouped into a set of overarching categories (key issues) by the research team

#### **D1.4 Regulatory frameworks for sustainable business model innovation and sustainable travel behaviour**

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3. Each key issue was then transformed into a hypothetical opportunity. For example, all participants stated concerns related to the retention of existing customers. This was transformed into an opportunity linked to an ambition to reach new customers via collaboration in the MaaS ecosystem
4. Hypotheses regarding opportunities were then linked to measurable targets, stated in terms of minimum success criteria following the lean start-up methodology
5. Minimum success criteria were then inserted into the respective IMOVE pilots, such that each organisational participant should aspire to achieve targets
6. Evaluation procedures were set up for each pilot with respect to each minimum success criterion.

In this manner, the action-research process served to reveal an extensive set of barriers and obstacles to MaaS developments in the Gothenburg living lab. As such, this living lab is presented in the next section as an in-depth case study.

## 4 DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS IN IMOVE LIVING LABS

IMOVE living labs include cities of Turin (Italy), Manchester (United Kingdom), Berlin (Germany), Madrid (Spain) and Gothenburg (Sweden).

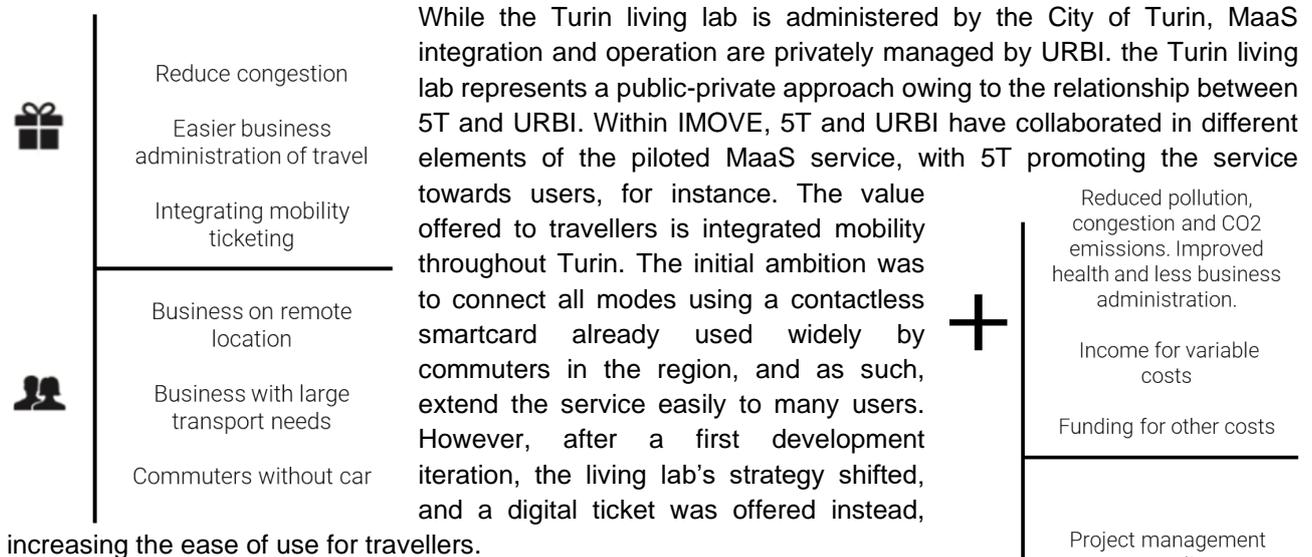
### 4.1 TURIN

	Population	880 000
	Companies	5T, City of Turin, FIT, URBI, Torino Wireless
	Mobility actors	ToBike, MiMoto, Wetaxi, GTT
	MaaS level	2 (Integrated payment and ticketing)
	Key segments	B2B and B2C
	MaaS approach	Public-private
	Business model	Public financing, project-based

**Figure 5. Turin Living Lab**

The Turin Living Lab is administered by the City of Turin with support from municipality-owned mobility firm 5T Torino, consultancy firm FIT, mobility integrator URBI and Torino Wireless. Turin has utilised a MaaS application based on the technology of URBI and trialled this MaaS solution in a first phase, targeting employees of General Motors offices in Turin as research subjects. A second pilot phase targeted a restricted sample of citizens. In both pilots, business-to-business and personal trips were covered via a pay-per-use MaaS option. The MaaS service also rewarded sustainable travel by displaying statistics on travel and awarding “green points” to travellers for selecting more sustainable trips. Further evaluation efforts involved surveying users and employers about MaaS as a travel tool for their organisation and private use. The project has been assisted by public financing in the start-up phase, but is operated by a private entity and is intended to serve as inspiration for a MaaS system that will serve the entire Piedmont region surrounding Turin. The public bodies acted as facilitators in bringing onboard transport operators and promoters in increasing awareness of citizens about the new mobility offer.

**4.1.1 BUSINESS MODELS**



increasing the ease of use for travellers.

Employees (in the first pilot) and citizens (in the second) have been offered subscriptions to the URBI offer, which integrates ticketing and payment for public transport tickets, two types of bicycle sharing (one station-based and one free-floating), and taxi services.

The business model also includes a double-sided linkage with benefits in two respects. First, one of the customers is large industrial district (General Motors) where an abundance of single-occupancy car commuters results in on-site congestion. The value is therefore to increase the attractiveness of commuting to work by means other than the personal automobile. Second, the living lab facilitates business-to-business trips and simplifies the billing process by sending bills directly to the recipient company (GM), reducing the need for laborious administrative processes.

**4.1.2 DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS**

The long-term ambition of the Turin living lab is to test the feasibility of a full MaaS solution in Turin. Rather than establishing a new business, the living lab’s goal is to utilise knowledge from the two IMOVE pilots as inspiration for a MaaS offering covering the entire Piedmont region. Hence there is no explicit long-term business plan, nor is there a corresponding strategy for different services and user segments. Instead, trials were established with the ambition of gaining knowledge about how MaaS can be managed in the future.

Interviews with 5T employees emphasised that a key enabler of seamless mobility in the region is the existence of a well-integrated public transport system. Public transport users from Turin’s suburban areas, for example, can already transfer seamlessly to urban public transport systems using the same ticket. Within the GM pilot, the support of mobility managers has been critical to promote the service among employees and recruiting pilot study participants.

In addition to IMOVE funds, funding for the living lab comes from the City of Turin, and is project-based, ending after the conclusion of the IMOVE project. The continuation of MaaS in the region depends on the ability to secure additional public funding, and the City of Turin has a plan to support further MaaS operations. The city has not finalised detailed specifications, however, regarding which business cases will be supported. These uncertainties constitute a potential barrier to MaaS developments beyond the IMOVE project.

Despite the importance of public transport for the Turin MaaS scheme, initial attempts to facilitate third-party ticket sales were resisted by the public transport agencies in the region. Hence the City of Turin lobbied the

local mayor to sign a directive statement that would force public transport to allow for third-party ticket sales for the duration of the IMOVE piloting period. The success of this approach meant that lobbying pressure from the City of Turin was critical to the launch of the two Turin pilots. That is, these pilots represented a novel development in that third-party sales of public transport tickets had never occurred in the Turin region previously. As explained by 5T officials:

“This is the first time the public transport company has sold tickets outside their own vendor network. It was very difficult to establish a commercial agreement that would allow for the possibility of selling single and daily tickets outside the vendor network of the public transport company. We are the first example of a party outside the [Turin] public transport company to sell single or daily tickets.”

A further barrier was that the pilots could only initially arrange to sell single-trip tickets via the URBI platform. As a 5T official explained: “It was very difficult to engage the public transport company here in Turin (GTT) and we are currently only able to provide the single-way ticket. The daily ticket needs additional technical integration, but the commercial agreement is already done.”

The living lab has experienced challenges attracting travellers to participate in piloting activities. As an attempt to overcome this barrier, recruitment bonuses were also introduced among individual travellers, and successfully promoted uptake. Existing users and early adopters of the Turin scheme are typically those who are interested in environmental issues and normally travel to work using public transport. However, some travellers who stated public transport as their preferred mode also demonstrated a lack of interest in MaaS. A dedicated focus group done with a sample of users revealed additional barriers, including unsatisfactory user experiences of the mobile app, and the absence of three popular mobility services within Turin (two carsharing operators and one bike sharing scheme), which limited the multimodal experience.

Finally, in Turin, URBI offers access to electric scooters in addition to the transport modes listed above. However, since electric scooters are not covered by employers’ insurance, the URBI app does not incentivise their use through its green point scheme. This helped the living lab to avoid liability, but limited opportunities for multimodality. Insurance liabilities thus constitute a further barrier to MaaS developments.

## 4.2 MANCHESTER

	Population	550 000
	Key organisations	Transport for Greater Manchester, Manchester City Council, Manchester Airport Group
	Mobility actors	Mobilleo
	MaaS level	2 (Integrated payment and ticketing)
	Key segments	B2B
	MaaS approach	Publicly-controlled
	Business model	Public financing, project-based

**Figure 6. Manchester Living Lab**

The Manchester Living Lab is administered by Transport for Greater Manchester (TfGM), the public transport authority for the Manchester metropolitan region. As an authority, TfGM oversees and subsidises a variety of transportation services. The transport landscape in the region is highly fragmented, as transportation services everywhere in the UK (outside London) are part of a deregulated institutional setting. Consequently, there are over 40 different private bus operators in the Manchester region.

From the beginning of the project, TfGM leaders have envisioned themselves at the centre of MaaS operations as a dual PTA/MaaS operator, and have used the living lab to conduct research that will support informed decisions about what types of MaaS solution will work well for the region and for TfGM. To this end, they have developed multiple concepts, tested business cases, and run small pilots designed to “fail fast”. These MaaS experiments are also seen to contribute to a master plan for mobility in the year 2021.

Project leaders started with an open mindset towards different technical solutions to MaaS and have had the ambition to evaluate different options through both IMOVE and MaaS4EU projects. The Manchester IMOVE living lab had the goals of exploring partnership agreements, technical specifications, and building a supportive community of operators willing to participate in a collaborative and integrated system. IMOVE and MaaS4EU allowed TfGM and wider partners to attend to risks of delivery and subsequent mitigation to overcome these challenges. It also allowed for the trial of one multimodal solution that could later be developed in full as part of TfGM’s current plans for a core sustainable transport network. The trial included bus, tram, on-demand bus (local link), taxi and car-share schemes in the regional centre. The living lab piloted transportation services to and from the Manchester Airport and involved the employees of large employers in and around the airport as users. The pilot utilised the Mobilleo technical platform and offered a pay-per-use option. Given the centrality of TfGM to living lab activities, and the fact that TfGM has procured the Mobilleo platform, the Manchester living lab represents a publicly-controlled approach to developing MaaS services.

**4.2.1 BUSINESS MODELS**

+	Non-montetary incomes Income for variable costs Funding for other costs	The most recent iteration of Manchester’s piloting activities has targeted employees commuting to and from Manchester airport. The main offer is affordable, car-free mobility. However, the ambition of the Manchester living lab was never to establish a validated business model, and a detailed model is yet to be defined. Instead, the living lab was developed in order to define the parameters of MaaS operations within the Greater Manchester region. That is, TfGM sees MaaS as an opportunity to better manage their transport network and to achieve sustainability goals within the region. Hence IMOVE is seen generally as a means to generate knowledge and insights related to the effects of MaaS, the requisite technologies and related capabilities, and the requisite organisational changes.
-	Project management costs, applicaton Variable costs from services	Within IMOVE, the Mobbileo platform has been procured by TfGM and therefore key activities have focused on platform management. Whether a MaaS provider will be procured by TfGM in the future, or be operated by a commercial actor according to a market-driven approach, is currently

unknown. Given the deregulated climate within which the living lab operates, it is unlikely that TfGM will adopt the role as MaaS provider. Therefore, TfGM sees other transport service providers and technical suppliers as key partners, and perceive their own role as concerned with managing MaaS developments at a more strategic level. Other key elements of the business model, such as the value proposition and customer segments, are yet to be defined. TfGM foresees potential in attracting dissatisfied public transport users and car owners to a standardised MaaS offer. In the future, the general structure of the business model may be publicly funded in part to allow the city of Manchester to retain control of the transport system and use MaaS to improve conditions in the metropolitan region. In such a scenario, the fixed costs will be covered financially by TfGM, but variable costs be covered by the users of the service.



**4.2.2 DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS**

The highly deregulated nature of Manchester’s transport landscape creates problems for actors who aim to establish commercial agreements or technical solutions for mobility integration. There are a multitude of transport service providers in Manchester and creating a MaaS solution with public transport as a backbone requires commercial and technical agreements with several of the 40+ bus operators active within the region.

TfGM discussed the introduction of a smart card that provides access to several bus operators within the region as a first step towards an integrated MaaS solution. In order to encourage different transport service providers to include their services within an in the future fully-integrated and digital solution, TfGM has framed MaaS as an opportunity for existing service providers to gain access to new customers and increase their business. Integration would also allow TfGM to better manage the mobility system within the region and make public travel more attractive.

A further problem is that there is an expanding number of mobility actors in Manchester, creating competition for market shares and potentially creating unnecessary congestion. The presence of multiple competing transport service providers acting in isolation also poses risks to public transport as a whole, as travellers

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perceive the system as complex, expensive and difficult to manoeuvre. One way to remedy this problem is to legislate a maximum capacity of certain mobility options within the region. However, TfGM lacks the mandate to institute such changes. Despite barriers to integration, MaaS offers a potential alternative to consolidate the transport system, to the extent it can be transformed from a fragmented disarray into a coherent, well-functioning system.

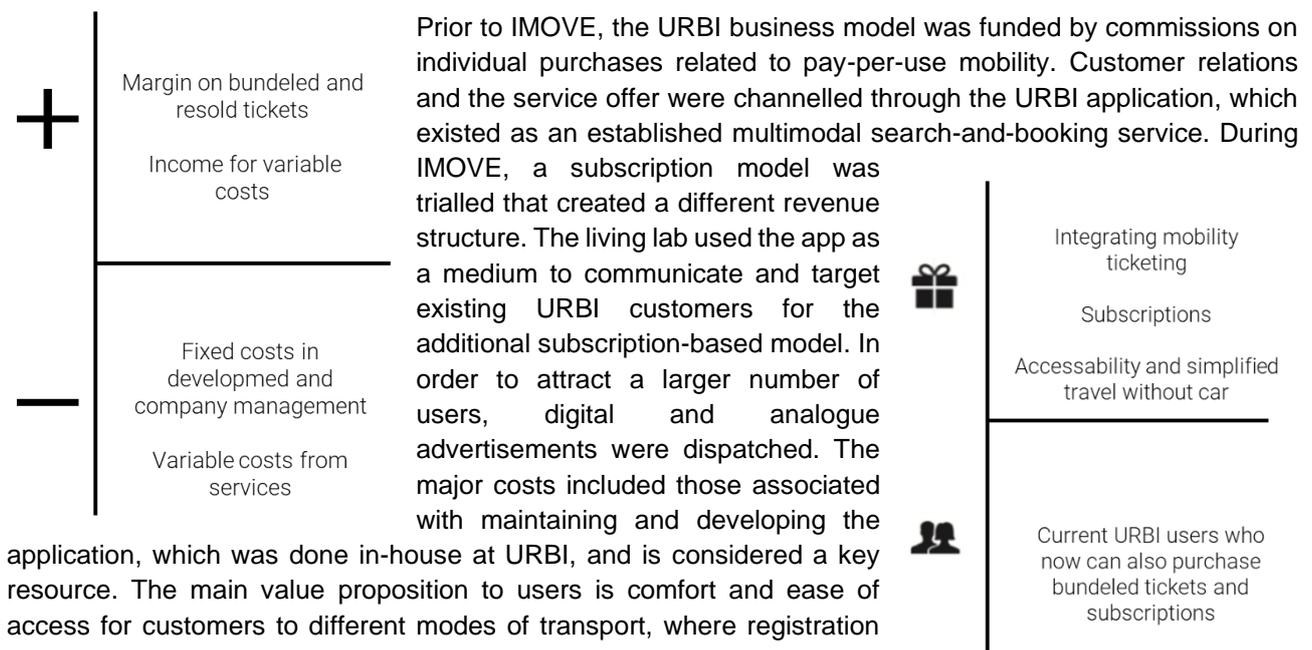
### 4.3 BERLIN

	Population	3 750 000
	Key organisations	URBI
	Mobility actors	Miles, Nextbike
	MaaS level	2+ (Integrated payment and ticketing, bundled ticket subscription)
	Key segments	B2C and B2B
	MaaS approach	Market-driven
	Business model	Public and private funding

**Figure 7. Berlin Living Lab**

The Berlin-based Living Lab is led by Italian-based transportation broker, URBI. Prior to IMOVE, URBI was already established as a mobility aggregator in Berlin, providing MaaS at level 1 and 2 depending on the mode of transport. The pre-existing application consisted of pay-per-use options for certain modes of transport. The goal within IMOVE was to develop a MaaS service that offered a single package with at least one provider per transport mode, with deeper integration and payment through URBI. As such, living lab aimed to trial prepaid subscriptions and bundling in order to find a more sustainable business model better suited to the Berlin environment. By the end of the project the ambition was to have a fully operational, technical and financially-viable MaaS service offered by URBI. Due to its established role as a transportation aggregator in the Berlin market, URBI built a coalition of transport suppliers. The Berlin living lab is based on the current URBI application with additions provided from the software enablers developed in the project as part of IMOVE WP2.

#### 4.3.1 BUSINESS MODELS



and ticketing could be completed on a single platform. A high level of collaboration was required with key mobility partners in order to ensure their commitment.

### 4.3.2 DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS

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Within the Berlin living lab, despite productive dialogues with different public transport providers, and even though all the necessary technical developments were in place, it was announced early in 2019 that Berlin's public transport operator BVG would cooperate with other partners to produce their own MaaS mobile application and service. This decision reshaped the MaaS landscape in Berlin, resulting in an unexpected setback to URBI's consolidation of different public and private transport modes in the region, and posed a barrier towards a fully integrated mobility service of all transport modes via URBI. Furthermore, URBI's customer-registration process reveals the challenge of integrating multiple transport operators, who each have a unique set of information variables required for their own sign up process, creating technical challenges to integration.

Another challenge related to customer registration is the unique billing processes established by each of the different transport providers. With regard to billing, one URBI officer explained: "Some providers charge by the minute, some providers charge by the kilometre, and some providers charge per ride. Ultimately, however, the end user pays for a single weekly or monthly subscription". In the living lab, this challenge has been circumvented by URBI purchasing credit from all service providers, and then bundling that credit through subscriptions offered on the mobile application.

A final regulatory issue for a fully comprehensive mobility service was the legislative prohibition of electric kickbikes in Germany, which hindered their introduction in a MaaS offering. However, this legislation was changed and, following a local adaption of the physical design of the electric kickbikes, they were included as part of Berlin's MaaS developments.

## 4.4 MADRID

	Population	3 235 000
	Key organisations	EMT Madrid
	Mobility actors	2 carsharing companies, 6 moto sharing companies, 5 e-scooter sharing companies, BiciMAD, urban bus, subway, regional trains and light rail
	MaaS level	2 (Integrated payment and ticketing)
	Key segments	B2C
	MaaS approach	Publicly-controlled
	Business model	Public and private funding

**Figure 8. Madrid Living Lab**

Public transport within and around Madrid is organised by the Regional Consortium of Transportation for Madrid (CRTM), a public transportation board that coordinates the rail-bound actors such as metro, light rail and trams together with each municipality’s own public transport. The City of Madrid has a fully-owned transportation company EMT Madrid, which is one member of the CRTM. EMT operates buses and cable cars in the regional public transport system. In Madrid there is also wide assortment of private mobility providers offering shared electric cars, electric kickbikes and electric motorbikes. These have been established following legislation and incentive schemes introduced by the city to offer free parking for electrified mobility options while limiting access to fossil-fuelled vehicles.

EMT Madrid envisions more sustainable transportation for Madrid, with the ambition of uniting all actors into a single ticketing service. In order to achieve this, EMT has decided to act as both a transport service provider and MaaS provider by developing their own MaaS mobile application. The development will be completed in two phases. Phase one, which was completed prior to Madrid’s entry into the IMOVE project, involved the aggregation of information and gathering all actors on the same platform. In this initial phase, no payment or ticketing was completed on the MaaS platform. Phase two aims at developing a ticketing, booking, and travel planning function in the application and will unite other actors in the transport system. This development will offer a Level 2 MaaS Service (integrating information, booking, and ticketing) with pay-per-use options but bundling, and thus Level 3 MaaS could be available in the future. The living lab is designed to implement both MaaS services and a platform, but also involves a future business plan where a commission on all MaaS trips will finance the development of the service over the next four years. The MaaS platform does not aim to generate profit but is intended as self-supporting scheme operated by a publicly-owned company. As such, the Madrid living lab has followed a publicly-controlled approach.

**4.4.1 BUSINESS MODELS**

<div style="font-size: 2em; font-weight: bold; margin-bottom: 10px;">+</div> <div style="border-left: 1px solid black; padding-left: 10px; margin-bottom: 10px;"> <p>3% margin on all sold tickets</p> <p>Income for variable costs</p> </div> <hr style="border: 0.5px solid black;"/> <div style="border-left: 1px solid black; padding-left: 10px;"> <p>Fixed costs in developed and company management</p> <p>Variable costs from services</p> </div>	<p>Project funding for the Madrid living lab was designated for the initial start-up phase. In the long term, the plan is to build up a user base that is strong enough to support a MaaS platform, independent of public financing. The cost of running a platform for all modes of transport will mainly be covered by charging a commission for all trips booked and performed through the mobile application. It was intended that multiple transportation actors would provide transportation services and sell these services through a common application; however the recruitment of users is dependent upon the further specification of customer segments. During the IMOVE living lab, the exact target customer segments was not clearly defined, however the ambition was to decrease car usage, which of course positions car owners as a potential customer segment. The main customer communication channel was traditional media coverage about the new service. The living lab was able to take advantage of an existing customer base already using an earlier version of the EMT Madrid app for searching and finding mobility options in Madrid. The proposed value proposition the possibility of purchasing tickets and bundled services, which will make car-free travel easier. The service offer started off as a pay-per-use offer, but the LL has since considered different types of bundling in order to adhere to ambitions of higher gains for the public and the individual.</p>	<div style="margin-bottom: 10px;"> <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 10px;"> <p>Searching and paying for all mobility</p> <p>Accessibility and simplified travel without car</p> </div> </div> <hr style="border: 0.5px solid black;"/> <div> <div style="border-left: 1px solid black; padding-left: 10px; margin-left: 10px;"> <p>Current MaaS Madrid users and new users</p> <p>Car owners</p> </div> </div>
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**4.4.2 DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS**

In Madrid, legislation exists to incentivise carsharing and electrified mobility services. This has already resulted in changed travel behaviour among citizens and has sown the seeds for MaaS developments. The Madrid living lab was initiated by EMT. Normally the regional public transport authority, CRTM, would be mandated to direct initiatives such as MaaS, but because of lack of action EMT Madrid decided to test MaaS for themselves in the hope of showcasing good solutions. The lack of engagement from CRMT constitutes a barrier to MaaS developments, given their influential role and the possibility that CRMT would perhaps create a MaaS solution with more reach. However, the decisiveness of and initiative taken by EMT has been critical to MaaS developments in Madrid.

Another informal barrier to MaaS developments in Madrid is the reluctance of transport service providers to join a MaaS platform. This was partially alleviated by a public company (EMT) adopting the role of integrator, albeit on commercial terms and with their own inclusion on the platform. A further key issue is that funding for a MaaS service was not possible in the long-term, since publicly-owned companies are not mandated to run MaaS services. This forced the project in Madrid to take a more commercial approach to MaaS, incentivising the development of a robust business model that could potentially resolve financing issues.

## 4.5 IN-DEPTH CASE STUDY – GOTHENBURG LIVING LAB

	Population	575 000
	Key organisations	Västtrafik, EC2B, SmartResenär, Göteborgs stadsförvaltningar, Västra Götalandsregionen
	Mobility actors	Göteborg Stads Parkering, Sunfleet, ZeeBee, Riskbyggen
	MaaS level	2 (Integrated payment and ticketing)
	Key segments	B2B
	MaaS approach	Market-driven
	Business model	Public and private financing, project-based

**Figure 9. Gothenburg Living Lab**

Gothenburg has a long history of MaaS developments, having hosted the world's first pilot (field operational test) of a MaaS offer as part of an R&I project (Go:Smart) that was initiated in the late 2000s. The Go:Smart project ended in 2014 with much success in terms of user satisfaction and modal shifts [47]. Since then, developments in MaaS have centred on exploring the different possible roles of public transport within a future MaaS system [23][48][49]. These developments have proceeded in three phases:

Phase 1: During the first phase, Västtrafik, the local public transport operator, considered adopting the role of MaaS operator via a concession tender whereby a commercial partner would be procured to operate a MaaS service. Due to a perceived lack of viable partners, and due to legislative restrictions, Västtrafik changed strategy, initiating phase 2.

Phase 2: This phase focused on Västtrafik's role in the creation of a national mobility market that would facilitate a commercial approach to MaaS developments via third-party resales of digital public transport tickets. This approach was governed by Samtrafiken – a national association of public transport authorities – and ultimately proved too ambitious for some of the organisations on the Samtrafiken board, who voted down a proposal in 2017.

Phase 3: In this phase, Västtrafik focused on the facilitation of third-party sales of digital tickets via a series of MaaS-pilots, following a directive from local county government officials within Västra Götalandsregionen. Both Västra Götalandsregion and Västtrafik are motivated to explore MaaS as a means to bring about more sustainable travel patterns within the region, doubling the modal share of public transport by 2025, compared to 2006 levels [27]. The IMOVE living labs are part of the phase three work and strategy.

Similar to other in highly-developed countries, the Gothenburg region is currently undergoing rapid urbanisation with ambitious urban redevelopments and a surge of in-migrants from other locations in Sweden. Urban redevelopment is focused on, among other things, creating a denser and more compact city centre, with multiple ambitious infill projects planned for completion before 2035. Transport and mobility are key elements of new urban developments, which seek to reduce the need for travel among sparsely-located city zones and reduce car-based travel via the provision of new mobility services, pedestrianisation, and by reducing the need for newly constructed parking infrastructures.

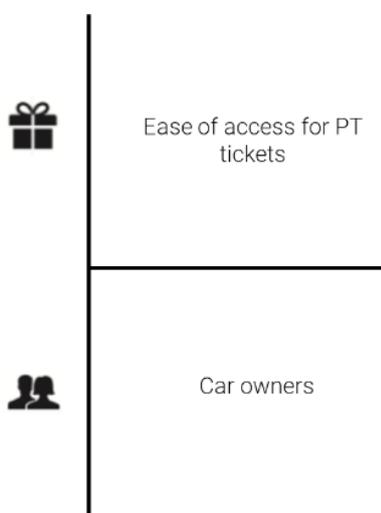
One distinguishing factor of the Gothenburg living lab is its level of digital maturity. This is largely due to Västtrafik’s role in pioneering a Swedish digital ticketing standard, entitled BoB (Biljett och Betal – translated as ‘Tickets and Payments’). BoB is designed as a standardised digital API that can facilitate third-party sales of public transport tickets and is part of a national strategy governed by Samtrafiken, whose primary objective is to coordinate and combine transport-related data and ticketing systems. Tight-knit collaborations between key players within the Gothenburg living lab and Samtrafiken have the resultant effect that many of the technical standards required to facilitate MaaS operations were established during the IMOVE project. This has allowed for a consolidated approach that targets the development of MaaS business models, which is seen by living lab partners as a critical issue. As a part of the IMOVE project, RISE has conducted a series of workshops with living lab partners involved in two pilots (pilots 2 and 3 – see below), with the aim of developing new – and refining existing – business models, based on the methodologies outlined in D1.1 and D1.2 (Sarasini et al. 2018). Gothenburg’s living lab is managed by the public transport operator Västtrafik, and IMOVE activities centre on three pilots:

**Pilot 1. Digital park and ride.** The first pilot involves a partnership between Västtrafik and Gothenburg’s publicly-owned parking company (Göteborgs Stads Parkering) and provides digital park-and-ride services in the B2C segment, whereby car users can purchase tickets for public transportation via a smartphone application provided by Göteborg Stads Parkering in the Västra Götaland county.

**Pilot 2. MaaS for property developers and residents.** The second pilot targets residents of a newly-built housing association (BRF Viva), which consists of residential apartments in central Gothenburg. This pilot involves a partnership between Västtrafik and EC2B, a commercial MaaS provider that presently offers level 2 MaaS services to residents within urban housing associations. The latter, together with property developers, have played a key role in facilitating this type of MaaS solution (B2B segment). It is important to note that Västtrafik has entered a three-way partnership in this pilot, with EC2B and also Smartresenär, who provide back-end platform functionalities.

**Pilot 3. MaaS for public employees.** The third pilot consists of a partnership between Västtrafik and SmartResenär, a commercial actor that has two main offers: a technical platform to facilitate back-end functionalities such as ticketing and payment distribution to upstream transport services providers, and a mobility management platform that is offered to public- and private-sector organisations (B2B segment). This pilot targets employees of three units with the Gothenburg city administration (stadsförvaltningar). However, over time the pilot was narrowed to focus on one organisational unit.

### 4.5.1 BUSINESS MODEL – PILOT 1



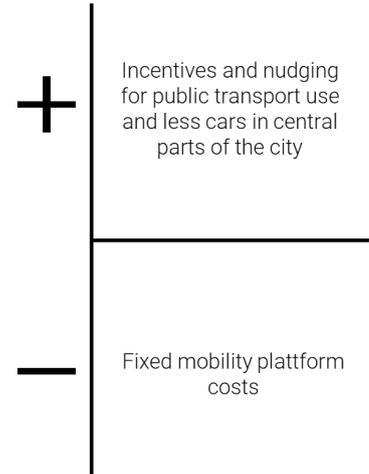
The digital park and ride pilot was initiated with the intention of trialling the BoB digital ticketing standard for the first time. The pilot was initiated in 2018 and originally aimed to test digital ticketing on a technical basis, although the pilot has since evolved to encompass a more commercial focus that examines the opportunities to encourage sustainable modal shifts within more densely-populated areas of the living lab.

From a business model perspective, digital park and ride is a relatively simple concept in that public transport tickets are offered for purchase via a smartphone application for parking. The parking app facilitates digital payments for parking, and users can access single or daily public transport tickets regardless of whether or not they purchase parking via the app. As such, the inclusion of public transport within the app constitutes something of a nudge for car owners (albeit without any discounts or rewards) to park their car and travel within urban areas using public transportation. The pilot is ongoing, and sales data

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demonstrate significant uptake, with over 3000 public transport tickets sold between April-September 2019. The digital park and ride service is publicly available and could be conceived of as targeting all types of car-based trips within the car owner segment. However, the actual targets are trips that are made on a more ad-hoc basis, such as shopping and leisure trips, which require temporary parking. Parking associated with routine car trips such as commuting to and from work usually involve the use of private parking or parking spaces that are rented on a long-term basis.



The main value proposition to end users is simplicity and convenience via multimodal inner-city travel. Car owners that travel into the city can park their cars at numerous locations in and around the city, and by switching to public transport, car owners can avoid problems linked to congestion and navigating the Gothenburg city centre, which has a congestion pricing system and is becoming increasingly pedestrian-oriented. Digital park and ride is thus seen as an opportunity to reduce the number of cars in busy urban centres, improving traffic safety and air quality. From the perspective of Västtrafik, the inclusion of public transport tickets in a parking app constitutes a new digital channel for reaching customers.

The business model encompasses a public-public partnership between Västtrafik and Göteborg Stads Parkering, with a relatively simple ecosystem configuration (Figure 10). The ecosystem is configured such that Västtrafik is repositioned further upstream in the value chain – adopting a role as a transport service provider. This is a somewhat novel role for Västtrafik with regard to digital ticketing, which was available only via their own app ToGo prior to the pilot. The pilot thus offered Västtrafik the opportunity to explore an entirely new type of sales channel, which they have dubbed ‘digital retailers’.

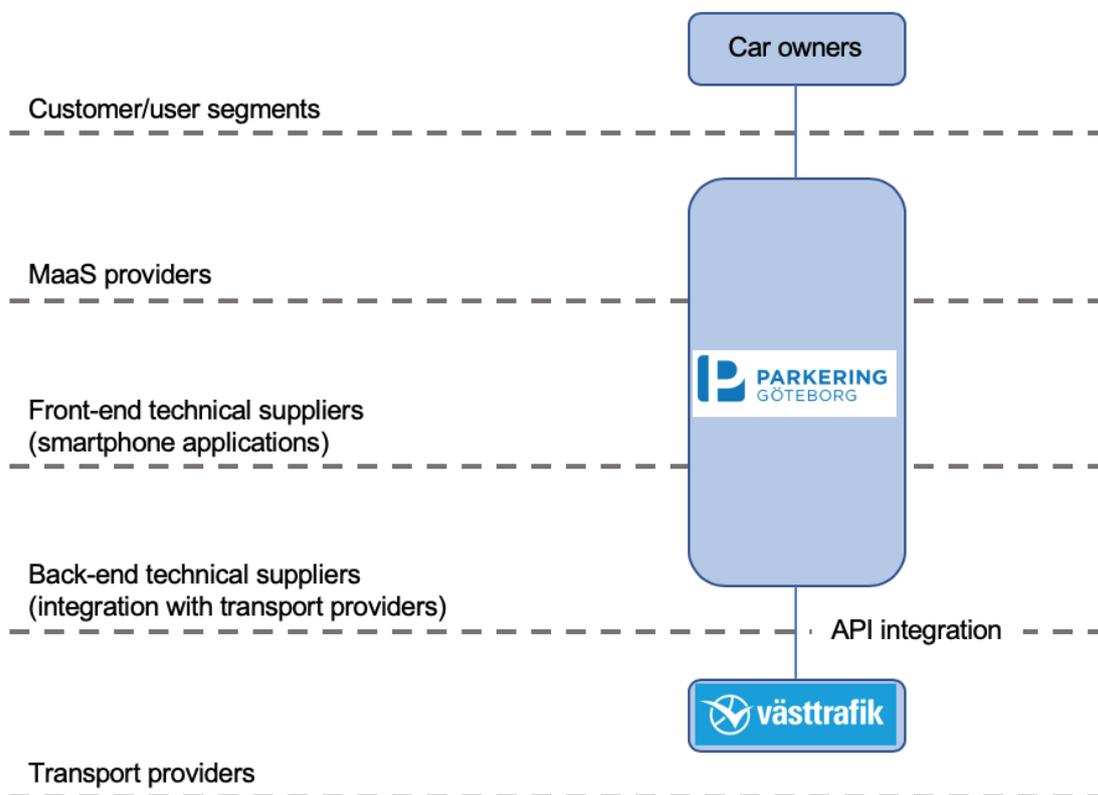
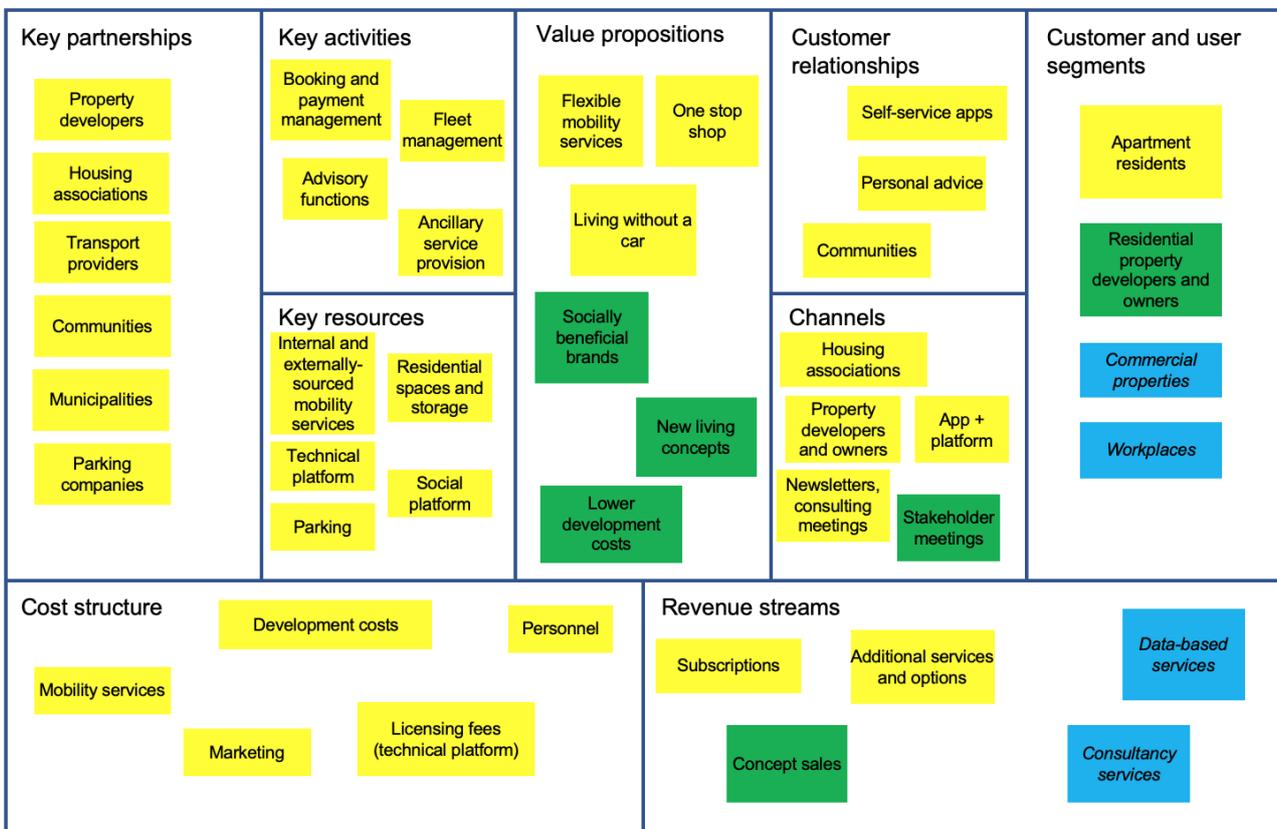


Figure 10: The MaaS ecosystem for the digital park and ride pilot within Gothenburg living lab.

**4.5.2 BUSINESS MODEL – PILOT 2**

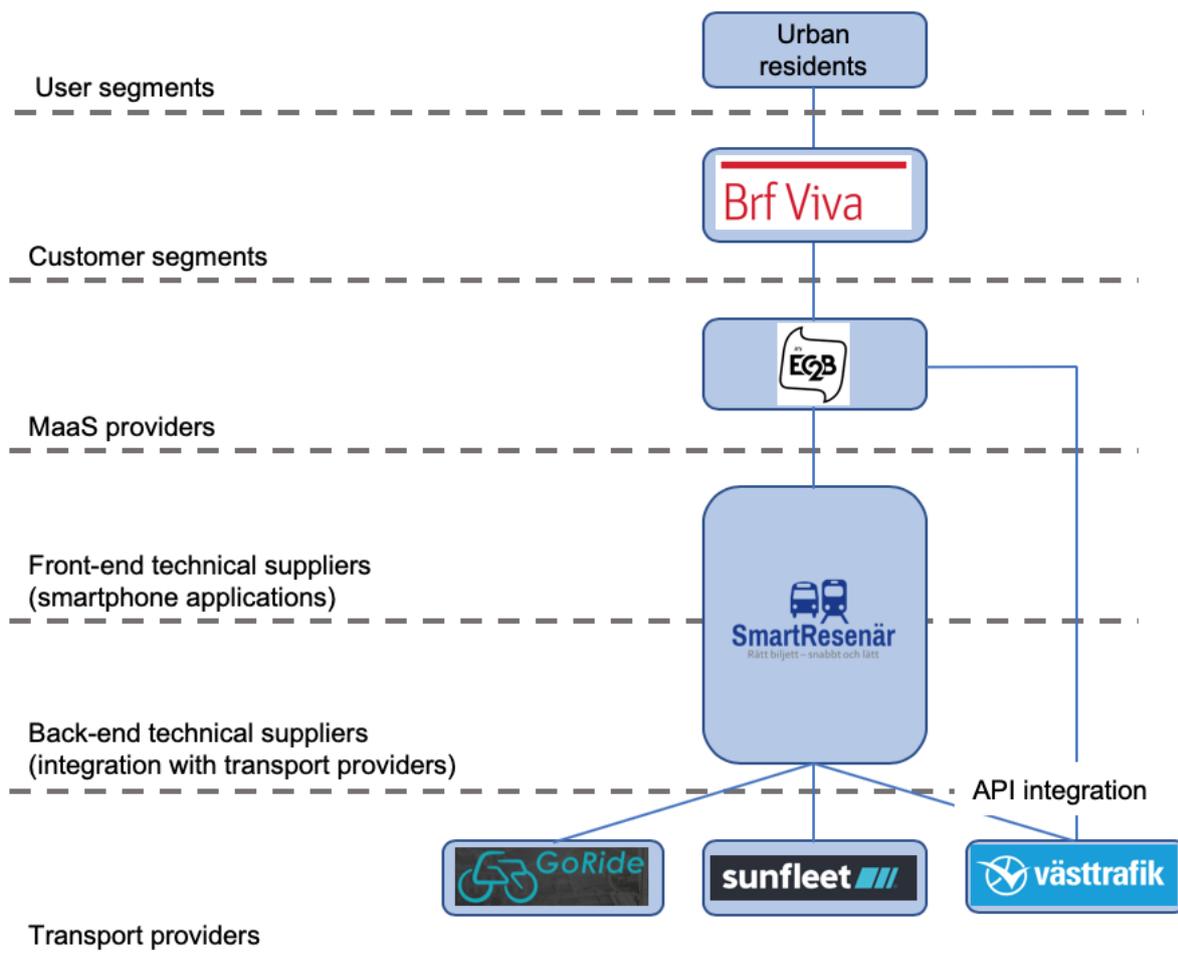
This pilot focuses on the delivery of the EC2B MaaS service to residents of a newly built housing development within central Gothenburg. The housing development (BRF Viva) was built with the aim of minimising the need for parking infrastructure, which was of interest to the property developer (Riksbyggen) for two reasons: 1) the possibility to make significant cost savings in the construction phase; and 2) the opportunity to support sustainable mobility and thus strengthen their brand. During the pilot phase, the service is operating at level 2 in the MaaS topology, in that different mobility services are made available via the EC2B app but are not (yet) fully bundled via a new, repackaged service offer. During the pilot (which, at the time of writing, is still ongoing), EC2B offers access to single, daily and monthly public transport tickets, car sharing (whose booking and payment system separate and linked to in the app), light electric vehicles, and a bicycle pool consisting of electric bicycles and cargo bicycles.



**Figure 11: The EC2B business model. NB: Italicised entries refer to hypotheses not tested within IMOVE.**

EC2B targets two customer segments: residents within urban areas and residential property owners / developers. The main value propositions to residents (marked in yellow in Figure 11) are car-free urban living, flexibility and a one-stop shop for mobility that is collocated with places of residence. By targeting residents within housing associations, EC2B aims to harness existing communities as a means to scale their operations. This is seen as a more effective marketing strategy than targeting the general public, and is seen as commercially beneficial since there is a higher willingness-to-pay for MaaS among property owners and developers. The main value propositions to property owners and developers (marked in green in Figure 11) are reduced development costs, brand opportunities linked to sustainability credentials, and the opportunity to experiment with new living concepts.

The business model encompasses a public-private partnership between Västtrafik, Smartresenär and EC2B, and private-private partnerships between EC2B, individual transport service providers (Sunfleet and GoRide), property developers (Riksbyggen), housing associations (BRF Viva), and a platform provider (Smartresenär). The MaaS ecosystem associated with this pilot is more complex than that of pilot 1 (see Figure 12). This is partly due to the higher number of actors within the value chain, but also because of the need to reconfigure pre-existing roles. That is, transport service providers are repositioned further upstream in the value chain in order for EC2B to create an integrated offer. Pilot 2 constitutes a commercial approach to MaaS, albeit with a strong public influence in that Västtrafik has worked diligently to enable this approach.



**Figure 12: The MaaS ecosystem for the residential pilot within Gothenburg living lab.**

### 4.5.3 BUSINESS MODEL – PILOT 3

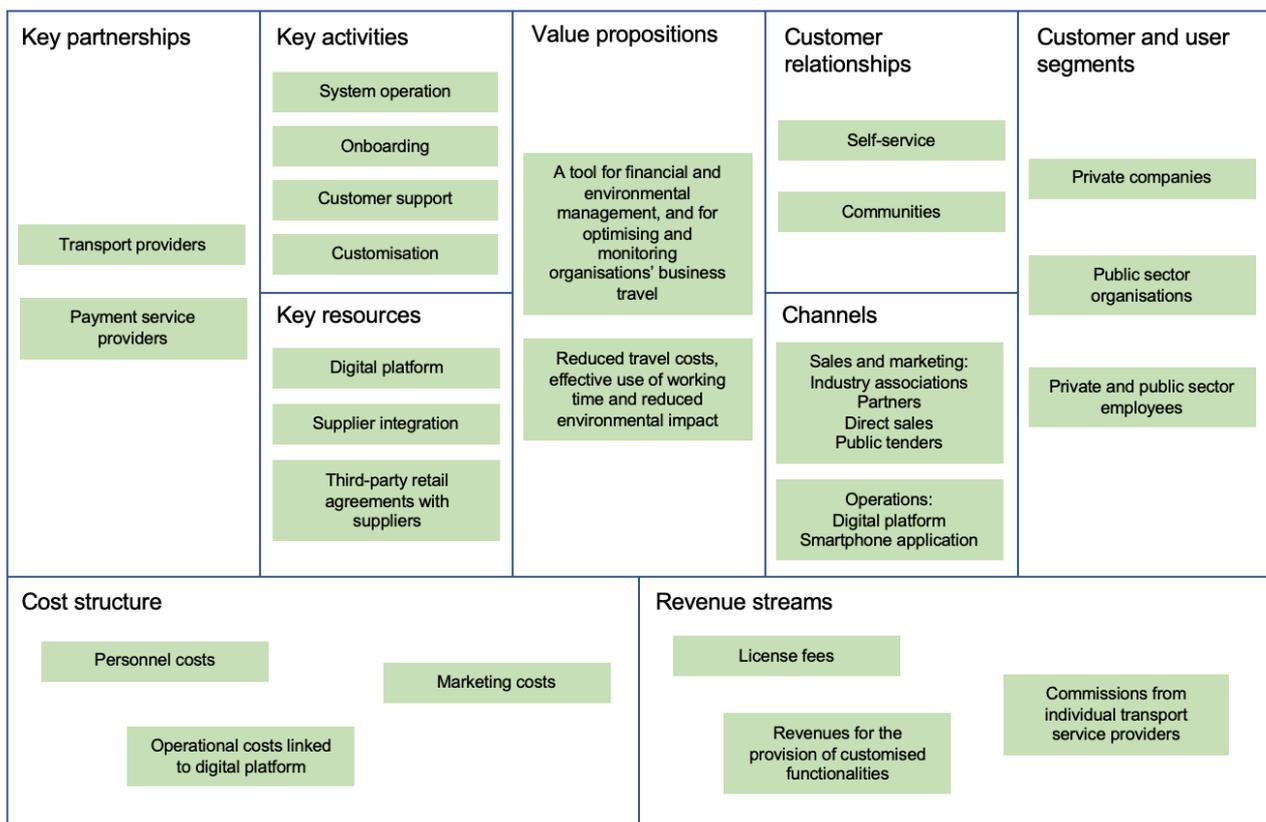
Pilot 3 focuses on the delivery of the Smartresenär MaaS service to employees within a public-sector organisation (three units within the Gothenburg city administration – stadsförvaltningar). At the time of writing, pilot two has been extensively planned, but has not yet been launched. The main offer centres on a mobility management platform for organisations that aims to resolve problems associated with employee travel. Organisations are typically equipped with different management systems for different types of employee travel linked to travel with different modes of transportation (usually a mix of travel bureaus and receipt and refund procedures), creating problems for effective administration and management. Hence the Smartresenär digital

**D1.4 Regulatory frameworks for sustainable business model innovation and sustainable travel behaviour**

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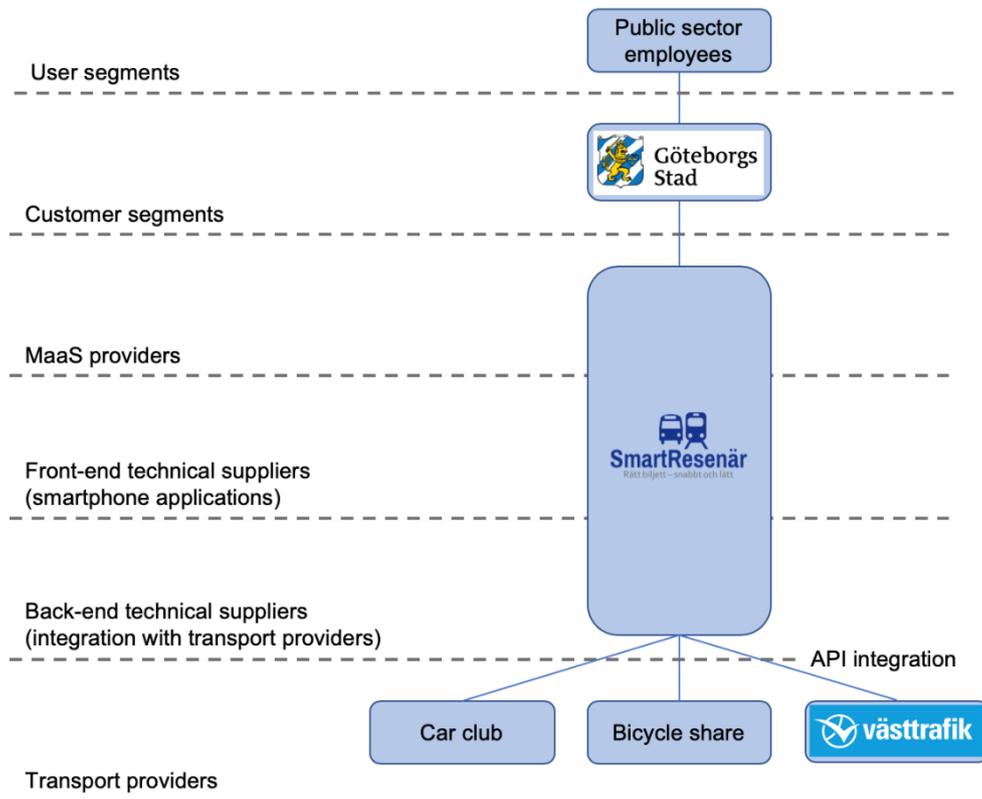
platform serves to reorganise and systematise employee travel by assimilating all modes and services, facilitating improved financial management, monitoring and optimisation, and enabling more effective environmental management. The platform also facilitates cost savings by reducing the complexities of planning, booking and administering employee trips, and by promoting shared modes, aims to reduce the environmental impacts of employee travel. These front-end mobility management functionalities are the main part of Smartresenär’s offer to organisations within the public and private sectors and constitute a level 2 MaaS offer. By targeting organisational customers, Smartresenär sees an opportunity to recruit large numbers of employees, as part of an approach that aims at harnessing ‘communities’. Back-end platform functionalities such as ticketing and payment distribution to upstream transport services providers, primarily public transport operators, enable a further offer to other MaaS operators (such as EC2B, hence the presence of Smartresenär in pilot 2). These are realised via partnerships with payment service providers and digital ticketing according to the BoB standard.

For both segments, revenue streams are sourced from licensing fees for the use of the platform, complemented by additional fees charged for delivering customised solutions and platform functionalities, and commissions for sales of public transport tickets (though these are relatively low). The business model is described in Figure 13.



**Figure 13: The Smartresenär business model.**

Within pilot #3, the MaaS offer integrates a car club and a bicycle pool, both of which are provided by the host organisation, and public transportation. This pilot is a further example of a commercial approach to MaaS, again enabled by strong leadership from the public sector via Västtrafik. The MaaS ecosystem is described in Figure 14.



**Figure 14: The MaaS ecosystem for the public sector pilot within Gothenburg living lab.**

#### 4.5.4 DRIVERS AND BARRIERS OF MAAS DEVELOPMENTS

Within the IMOVE project, support has been given to MaaS piloting within the Gothenburg living lab in the form of a series of innovation workshops that target the development of new MaaS business models. The innovation workshops have focused exclusively on pilots 2 and 3, and served to reveal a set of drivers and barriers to MaaS developments experienced by Västtrafik, EC2B and Smartresenär. The most salient drivers are (in order of importance):

- The perception of MaaS as a business and innovation opportunity
- Opportunities for these organisations to reach new customer segments
- The possibility of facilitating shifts towards more sustainable travel patterns
- Political directives from the local PTA forcing the facilitation of third-party public transport ticket sales (relevant only to Västtrafik)
- Improvements to corporate brands and images
- Making improvements to accessibility within the region
- National targets to increase the number of public transport trips (relevant only to Västtrafik)
- Potential cost savings for transport service providers (relevant only to Västtrafik)
- Market competition among MaaS providers
- Developing a more attractive region for citizens (relevant only to Västtrafik)
- Organisational learning regarding digital ticketing and third-party sales
- The opportunity to scale MaaS services following the pilot period.

With regard to barriers, the three organisations that are central to commercial IMOVE pilots perceive the following as risks and obstacles to future MaaS developments.

**Barriers to collaboration in the MaaS ecosystem**

During the IMOVE innovation workshops, Västtrafik, EC2B and SmartResenär each expressed concerns that entering into partnerships to deliver MaaS could potentially result in risks to their respective brands and existing customer relationships, and highlighted the potential risk of losing customers to other actors within the MaaS ecosystem. Within the MaaS ecosystem trialled via Gothenburg pilots, Västtrafik adopts a role further upstream in the value chain as a transport provider, which is perceived as a potential threat of losing touch with customers. By contrast, Smartresenär voiced concerns that Västtrafik could start to offer MaaS services, resulting in a cannibalisation of their own offer. Furthermore, MaaS providers Smartresenär and EC2B expressed difficulties in engaging other well-established transport providers in the ecosystem given a reluctance to collaborate due to the same perceived risks outlined here. These barriers to collaboration are, despite the drivers and motives of MaaS developments listed above, due to the novelty of the MaaS ecosystem and the need to adopt new- and reconfigure existing roles in the value chain.

A further reported risk to ecosystem collaboration is uncertainty created by the temporary nature of the pilots and agreements between partners. This risk is felt most acutely by EC2B and Smartresenär, both of whom expressed the importance of their licence to operate as a third-party reseller of public transport tickets under a clear and stable set of rules. They also expressed concerns that failure to establish agreements for the period following the pilots would result in interruptions to the supply of tickets and a consequent disruption to their services that would damage brands and customer relationships. Regarding this point, two types of partnerships were discussed during the innovation workshops, which have been named “digital retailers” and “mobility partners”. Digital retailers encompass simple partnerships with third parties such as retail kiosks, hotels, tourist attractions and event organisers that wish to sell public transport tickets to existing customers and guests. Mobility partners encompass deeper partnerships with third-party MaaS providers that bundle public transport with other transport services as part of a new mobility offer. Both EC2B and Smartresenär are considered potential future mobility partners: Västtrafik is currently considering whether they are legally obligated to establish such partnerships via public tenders of concession contracts. Uncertainties in these processes and the time required for potential tenders are central to operators’ concerns regarding the instability and lack of clarity regarding the license to operate following the pilot period.

**Uncertainties related to the financial viability of MaaS**

EC2B and Smartresenär both expressed concerns regarding the business case for MaaS. Despite the fact that both these operators both that customers in the B2B segment expressed a willingness to pay for MaaS, they remain concerned about the possibility of developing a viable business model. This is reflected by concerns voiced during innovation workshops about the rate of commission granted to them by Västtrafik – 2.5% for single tickets, no commissions for other ticket types during the pilot period (this means that EC2B and Smartresenär lose revenue on public transport ticket sales due to transaction costs). In addition, uncertainties related to commission levels following the pilot period make it difficult for EC2B and Smartresenär to create robust business cases for MaaS, which in turn creates obstacles for long-term investments.

Consequently, EC2B and Smartresenär have expressed a desire to receive commissions at a level that “reflects the value added via their channels”, providing the opportunity to develop a more viable business case. In order to deal with these expectations, the IMOVE innovation workshops examined the types of value that can be generated via partnerships between public transport operators and MaaS providers. These discussions centred on a set of “key issues” common to each of the three participating organisations and sought to transform problems into opportunities by creating a set of testable hypotheses, some of which could be tested and evaluated during the pilot period. In order to evaluate each hypothesis, minimum success criteria were established alongside measurement techniques that have been deployed during the pilot (see Table 2). The aim of this exercise was to generate an empirical base that can influence decisions related to future partnership

opportunities (i.e. via agreements between Västtrafik and third-party retailers). In practice, however, the revenues generated via MaaS must likely be generated commissions from actors other than public transport operators in order to derive a viable business case.

The financial viability of MaaS is further complicated by uncertainties regarding market demand and willingness-to-pay for MaaS, particularly among individual travellers within each of the user segments that may broadly be referred to as the general public (e.g. commuters, leisure trips, shopping trips, etc.). Whilst this creates uncertainties related to the financial viability of MaaS business models, another consequence is that MaaS providers within Gothenburg have targeted organisational customers, where demand and willingness-to-pay are more discernible, and risk mitigated by serving a large customer. Targeting organisational customers may be a first step in reaching broader publics, but it also offsets the opportunity to bring about more sustainable travel patterns within segments that have a large potential for gains. One other aspect of the IMOVE innovation workshops was to discuss the content of contracts that would provide the basis for partnerships between Västtrafik and MaaS providers following the conclusion of the piloting period. Within Västtrafik, the level of expertise and interest in MaaS is not distributed evenly. Some key individuals and parts of the organisation lack knowledge and competence, and others are simply focused on other tasks. Further, by delving into MaaS, public transport operators are exploring new territory. As such, there is a lack of administrative models and established standards and practices for dealing with MaaS and for procuring third-party retailers, both within individual public transport organisations and across the sector as a whole.

Within the B2B segment, MaaS developments are further inhibited by a lack of key competences and procedures among customer organisations. Organisational customers typically lack administrative systems that would provide them with an overview of employees' travel patterns and needs, and there is a lack of standardised methods for calculating organisational travel costs. A concomitant lack of information related to employee travel makes it difficult for MaaS operators to demonstrate the benefits of procuring a MaaS-based system. Within the public sector, organisations are forced to procure MaaS via public tenders. However, public sector organisations are challenged by limited awareness and knowledge of the MaaS concept, which does not typically feature as a service-category in procurement guidelines.

	Key issues			
	New Customers and Sustainability Impacts		Brands	
	Pilot #2	Pilot #3	Pilot #2	Pilot #3
<b>Customer / user segments</b>	BRF Viva / residents	Gothenburg City Administration / employees	BRF Viva / residents	Gothenburg City Administration / employees
<b>Problem-based objectives</b>	<p><i>Västtrafik</i>, <i>EC2B</i> and <i>Smartresenär</i> all aim to attract new customers via new MaaS offers</p> <p>All parties aim to bring about more sustainable travel patterns among individual MaaS users</p>		<p><i>Västtrafik</i>, <i>EC2B</i> and <i>Smartresenär</i> all aim to improve their brands via MaaS partnerships</p>	
<b>Assumptions</b>	Some individuals within the existing private car segment either do not want to travel by car, or do not want to own a car		<p>Some potential users are unsatisfied with their current means of transportation</p> <p>Improved user satisfaction will result in improved brand value</p>	
<b>Hypothesis</b>	MaaS services will attract users from the existing private car segment		MaaS services will result in a higher level of user satisfaction compared to existing means of transportation	
<b>Minimum success criteria</b>	<p>20% of the total number of trips that would otherwise have been made with a private car will be fulfilled by the <i>EC2B</i> MaaS service</p> <p>50% of the trips completed via <i>EC2B</i> will comprise travel using public transport, bicycle or walking</p> <p>Campaigns to attract new customers to public transport via <i>EC2B</i> will have a higher uptake (40%) than campaigns traditionally run by <i>Västtrafik</i> (30%)</p>	<p>20% of the total number of trips that would otherwise have been made with a private car will be fulfilled by the <i>Smartresenär</i> MaaS service</p> <p>50% of the trips completed via <i>Smartresenär</i> will comprise travel using public transport, bicycle or walking</p>	<p>Evaluations of user satisfaction before and after the piloting period demonstrate higher levels of satisfaction related to the different qualities of piloted services</p> <p>Pilot users demonstrate a higher level of satisfaction when compared to <i>Västtrafik</i>'s customers and users</p>	
<b>Evaluation methods</b>	Travel surveys, electronic diaries	Travel surveys	Travel surveys, interviews, focus groups	

**Table 2: Key issues, hypotheses and minimum success criteria established within IMOVE innovation workshops.**

## 5 DISCUSSION

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Mobility as a Service (MaaS) has emerged as a potential new model for urban mobility in Europe and on other continents. Ideally, MaaS integrates planning, ticketing, and payment for multiple transportation modalities into a single service offering, helping to lower the real and perceived barriers to using modes of transportation other than the personal motor vehicle. As such, MaaS may be seen as a natural extension existing transport systems. The integration of individual services into MaaS solutions can deliver convenience, accessibility and flexibility to individual travellers. However, for much of the past century, urban growth in developed countries has accommodated and often prioritised single-occupancy motor vehicles [50]. Meanwhile, other modes of transportation have evolved in functional silos: each has distinct routes, and separate ticketing and payment systems optimised for the efficiency of that particular transport service rather than for fulfilling the complicated needs of urban travellers. Hence transitioning away from today's fragmented transportation arrangement towards a more integrated, MaaS-based system involves overcoming a set of barriers related to existing legislation, incentive schemes, business models and culture. The real challenge is not only technical – it also involves overcoming social structures embedded within the transport system.

At the outset, this report posed the following questions, designed to explicate ways in which MaaS developments can be governed given the complexities of each living lab:

- Why are key stakeholders and transport providers motivated or pressured to develop MaaS solutions?
- What challenges, barriers and obstacles have they faced?
- How have key challenges, barriers and obstacles been addressed?
- What actions are required within the public and private sectors to promote MaaS developments in urban settings?

In the paragraphs that follow, we address these questions by summarising the findings of this report and by eliciting key implications for the governance of MaaS developments, both within and beyond IMOVE living labs.

### 5.1 DRIVERS OF MAAS DEVELOPMENTS IN IMOVE LIVING LABS

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The IMOVE living labs are each furnished with different mobility landscapes; are each subject to a unique set of institutional arrangements; have varying levels of ambition among public and private actors; and consequently, each face their own particular challenges. Owing to the diversity of each city within the IMOVE project, the drivers and motives of MaaS developments listed below are not consistent across all living labs. Contextual diversity is also reflected in the varied approaches taken to organising MaaS schemes within each of these cities.

Each of the IMOVE living lab partners stated that sustainability objectives are a key motive of MaaS developments within their own constituencies. In particular, living lab partners perceive MaaS as an opportunity to promote more **ecologically sustainable travel patterns and reductions in congestion**. This can be achieved by encouraging travellers to adopt more environment-friendly transport modes such as public transport, cycling, walking and other shared modes over the use of private cars. MaaS is also linked to the opportunity to **consolidate existing, fragmented mobility schemes** (most evident in the Manchester living lab, where fragmentation has escalated given the deregulated transportation climate) and to **simplify mobility for travellers** via integrated services that unify planning, booking and payments. The integration of existing mobility services is also seen as a means to improve the **attractiveness and accessibility** of each living lab region. Within some of the IMOVE living labs, MaaS is also seen as a **business and innovation opportunity**

that can allow existing service providers to reach new customers and users, to strengthen their brands, and to derive cost savings associated with marketing activities.

Another set of drivers and motives of MaaS developments evident throughout the project is linked to **learning, knowledge generation and competence development**. Given the novelty and radical nature of the MaaS concept, several actors within each of the IMOVE living labs have used the project as a platform for learning, focusing on a number of key themes. First, the IMOVE project has served as base upon which to **develop, test and trial multiple incarnations of the MaaS concept**. This is evidenced by the different approaches adopted to roll out MaaS schemes within each living lab (market-driven, publicly controlled and public-private approaches); the various customer and user segments targeted; and the existence of multiple pilots and trials within some of the living labs (Gothenburg, Manchester, and Turin). In sum, the different forms of experimentation represent different innovation pathways that, when compared and contrasted, provide key insights regarding the governance of MaaS developments, within and beyond the IMOVE project (see section 5.2). Second, living lab partners have used the IMOVE project to **explore their and others' roles within the MaaS ecosystem**. Again, this is evidenced by the different approaches adopted to roll out MaaS schemes within each living lab, both in terms what has occurred within IMOVE pilots and with regard to contemplation over future developments. It is also evidenced by the extensive dialogues among service providers within each living lab, and by interactions with key ecosystem stakeholders that govern key institutional arrangements (e.g. the Turin living lab, where lobbying efforts were required to gain a mandate for the inclusion of public transport in piloting activities). Third, living lab partners have, to varying degrees, sought to **generate technical competences and capabilities**. This is evidenced by the varied utilisation of software enablers developed in WP2 and licensing of third-party digital platforms among some living lab partners, and, among others, the inhouse development of platforms and digital tickets that have been trialled them via IMOVE pilots. Regardless of the approach, these efforts represent the motive to acquire the necessary technical enablers for MaaS among living lab partners. Fourth, living lab partners have used the IMOVE project to **explore ways in which to establish MaaS-related activities within their own organisations**. This is particularly evident within the Gothenburg living lab, where the local PTO has thoroughly investigated the implications of MaaS vis-à-vis internal ticketing protocols, marketing activities, procurement obligations and so on. Finally, the IMOVE project has served as a means to **explore the sustainability impacts of MaaS**. To varying degrees, living lab partners have sought to explore potential changes in travel patterns observable via piloting activities, although the data on this topic is limited.

## 5.2 OVERCOMING BARRIERS TO MAAS DEVELOPMENTS

The IMOVE project also serves to highlight a common set of barriers and obstacles to MaaS developments within urban settings and provides insights as to how these may be overcome, with implications for the governance of MaaS developments in urban settings. In what follows, we outline two types of governance implications – those that pertain to the governance of MaaS trials, experiments and pilots; and those which pertain to regulatory changes that can be instituted to support the development and diffusion of MaaS.

### 5.2.1 THE GOVERNANCE OF MAAS TRIALS, EXPERIMENTS AND PILOTS

Across the IMOVE Living Labs, transport service providers demonstrated a reluctance to collaborate in MaaS ecosystems due to a set of perceived business risks. These risks include the belief that MaaS may lead to the cannibalisation of existing service offers, a loss of brand visibility, and a loss of control regarding customer relationships and user data. Such barriers must be overcome to develop multi- and intermodal MaaS solutions that are an attractive alternative to car ownership and use. Effective means to overcome barriers to ecosystem collaboration are to **identify perceived risks and barriers to collaboration at a local level, and to transform these into opportunities in the form of shared goals and objectives**. Irrespective of whether goals and

objectives refer to societal benefits or commercial gains (e.g. sustainability impacts and improved accessibility vs. targeting new customers and users of the service), **MaaS pilots and trials should be designed to reflect shared goals and objectives via realistic and measurable targets, again established at the local level.** That is, pilots must be designed to facilitate robust assessments and provide an evidence base for future negotiations among actors in the value chain. As an example, this approach bore significant fruit in the Gothenburg Living Lab where several barriers to ecosystem collaboration were identified, renegotiated and successfully overcome.

A further barrier to MaaS developments in IMOVE living labs was poor uptake among individual travellers. Prior to the IMOVE project, there was a lack of knowledge on key aspects related to individual travellers that influence the design of MaaS services. For instance, there was limited knowledge on what motivates travellers to trial or purchase MaaS services; a lack of knowledge on how travellers' needs and preferences vary between segments and uncertainties regarding willingness to pay for MaaS. Generally, these uncertainties create problems in designing attractive MaaS services, in developing viable business models, and in creating socially-inclusive services. The IMOVE project sought to overcome these barriers by investigating travellers' needs in a nuanced fashion, that is, by identifying specific customer and user segments, by investigating their needs, and by following an iterative process of generating and testing hypotheses according to a lean approach. This approach was successful in generating key insights, but some of the pilots nonetheless faced difficulties in promoting user uptake. Hence in addition to **investigating the needs and preferences of customer and user segments in a nuanced fashion**, it is important to **consider ways to attract larger numbers of users, both when rolling out pilots and launching commercial services.**

There are a number of actions that can be taken to promote user uptake. First, MaaS service providers can ensure that users can trial MaaS on a low-risk basis. The concept of **low-risk trialability** has proven successful in MaaS pilots beyond the IMOVE project [47], and can be implemented to ensure that users can flexibly and affordably trial MaaS, as was the case in the Turin living lab. Concrete measures to ensure low-risk trialability include flexible subscription agreements that allow users to cancel without long notice periods, monetary incentives, discounts or rewards to trial MaaS, and rebates for the loss of cars' residual value in cases where users do not use their cars during the piloting period. Second, actors within local MaaS ecosystems should collectively seek to **raise awareness of the MaaS concept** as a means to promote uptake. Concrete measures include advertising in the mass media, social media campaigns, engaging communities such as housing associations, and marketing via large employers and business parks. Engaging local influencers is a further option. Finally, local MaaS ecosystems can seek to create **visions and roadmaps that will lead to mass-market penetration.** This step is paramount and should draw upon key lessons from pilots and experimentation with the MaaS concept to map out **stepwise pathways** to successful commercialisation and scaling of MaaS services. A first step may be to consider which segment/s can ensure significant market uptake, whilst balancing against the needs for financially viable business models. Broadly, the B2C segment offers potentially high sales volumes given that several trip types may be covered (commuting, leisure, shopping, etc.). However, the B2C segment may suffer initial low uptake due to a lack of awareness among the general public and, as some IMOVE pilots have demonstrated, lower margins for MaaS service providers. Targeted actions are thus required, whereby mediating organisations such as housing associations can 1) ensure a higher uptake by harnessing local communities, and 2) provide a higher willingness-to-pay, creating better conditions for financial viability. By contrast, the B2B segment can attract larger numbers of users, but is potentially subject to lower sales volumes. That is, targeting large employers can ensure a larger number of users by capitalising on mobility management schemes, but employees generally travel less frequently than the general public, making it harder to derive a viable business case. In some instances, MaaS providers can target the B2B segment and seek to capture commuter trips (as is the case in Turin), but this may not always be possible. Notwithstanding, **stepwise pathways that seek to balance between market uptake and financial viability are essential.**

A final recommendation is linked to the sustainability impacts of MaaS. At present, there is a lack of knowledge on this topic in the form of robust assessments of MaaS, regarding the interplay between MaaS service content and emergent travel behaviour, and on what motivates or incentives travellers to make sustainable modal choices. Hence some key organisations, particularly within the public sector, are concerned that MaaS will lead to increased (rather than reduced) travel and that travellers will opt for less sustainable modes resulting in a net transfer from walking, bicycling and public transport to taxis, rental cars and car clubs. It is thus critical that the **sustainability impacts of MaaS are assessed in a robust and quantitative manner**, in order to facilitate decision making and garner support from key stakeholders within local MaaS ecosystems, especially those within the public sector. Assessments are a critical first step in creating legitimacy for the MaaS concept, aligning developments to societal goals, and in advocating for public support via policy instruments that channel fiscal resources into MaaS schemes (e.g. subsidies, tax exemptions, investment capital). **Sustainability assessments are also a useful means to garner support from key public stakeholders (particularly city administrations) who can play a critical role in creating the conditions in which MaaS is more salient.** This can involve policy measures that increase the cost of purchasing and using a motor vehicle, raising parking fees, eliminating parking space requirements for new residential developments, instituting congestion pricing, increasing fuel taxes, and redistributing taxation revenues into MaaS initiatives.

## 5.2.2 REGULATORY CHANGES THAT CAN SUPPORT THE DEVELOPMENT AND DIFFUSION OF MAAS

The following recommendations for regulatory changes that can support the development and diffusion of MaaS are drawn from experiences within the IMOVE project alongside previous and ongoing research projects on this topic (e.g. KOMPIS [51], MaaSFie [52], ODIN [53], IRIMS [54], SHIFT [55]). For the most part, these recommendations target regulatory changes that can be instigated by European institutions and filter down via member states' national, regional and local governments to influence local urban developments.

### 1. Ensure that a well-functioning public transportation system is in place

Whilst this may seem an obvious point given the notion that public transport comprises the “backbone” of MaaS systems, many cities do not have a public transportation system that is regarded as reliable and accessible, providing good coverage to key locations. Further, within some European jurisdictions, public transportation is organised in a manner that precludes MaaS developments due to the multitude of public transport operators within a given urban area. This type of setup can arguably discourage citizens from using public transport and can also create problems in integrating public transportation in a meaningful way within MaaS ecosystems. In such circumstances, local PTAs should be given mandates to develop unitary payment systems and create agreements to facilitate the integration of multiple public transport operators within a MaaS scheme.

### 2. Promote the deployment of digital ticketing schemes for public transportation, supported by national standards

Without digital ticketing, bundling and repackaging public transport becomes a cumbersome and costly task for MaaS providers, particularly in market-driven approaches. Although other mechanisms exist to facilitate the integration of public transport ticketing and payments (e.g. the Oyster card in London), none are as appealing as digital ticketing, as the latter is more aligned with the digitalisation of transportation vis-à-vis smartphone applications. Put differently, MaaS apps are more preferable among most user segments than alternative interfaces and align with the user-centric, seamless and convenient ethos reflected in the MaaS discourse. Moreover, we recommend European member states establish national standards for digital ticketing within public transportation, as this is a first step towards interoperability and roaming. To this end, one may take note of the German *Verkehrsverbund* model, developed during the 1990s, and the Swedish *BoB* model (noted previously) – part of ongoing developments managed by *Samtrafiken*.

**3. Encourage the development of open data standards on at member state level, for some datasets related to public transportation**

At a bare minimum, data on the pricing and availability of different transportation services is required for a MaaS system to function. At present, initiatives such as the Nordic ODIN project aim to create standards for the provision of open data related to public transportation regarding stops and stations, routes and schedules, travel planning, fare information and rules, ticket sales services and real-time data. Whilst some member states provide this data on a national basis, there is a lack of international standards, which constitutes a barrier to interoperability and roaming, and also the development of third-party MaaS services. Despite the presence of EU regulations to govern the provision of open data for public transportation, regulation is not well-understood within the transportation sector, and member states have implemented open data protocols in a diverse, non-standardised fashion. Given the importance of this type of data for MaaS developments, it is paramount that the EU acts to support standardisation procedures across member states.

**4. Allow for further trials and experimentation before legislating on data-sharing agreements**

One other related issue is that of access to customer and user data within local MaaS ecosystems. At present, the issue of user data ownership is hotly contested when seeking to promote collaboration within local MaaS ecosystems and is thus a precursory barrier to the development and implementation of MaaS services. Typically, established transport service providers are either reluctant or unwilling to share data on their existing customer base as they see this as a valuable asset. The prospect of entering into collaborative agreements via MaaS developments thus raises complex questions related to the ownership of user data, with regard to both existing and newly recruited customers. Previous research, in addition to that performed via IMOVE living labs, has shown that protectionism regarding user data is one of the key obstacles to the development of MaaS.

At present, the complexity of this issue has not been resolved in a satisfactory way. Within the Gothenburg living lab, discussions on this topic arrived at a potential solution – that data on “*new*” users (i.e. those customers that adopt a MaaS service having not previously been classed as active users among any of the individual transport service providers within a given MaaS ecosystem) should be *shared among service providers within the MaaS ecosystem in an open way*. This solution is promising in the sense that it 1) can be seen by value chain actors as an acceptable resolution to the data sharing problem; and 2) it is compliant with GDPR legislation. However, research on this topic is too immature to offer a validated solution that can be enacted as an international standard via EU policy. Instead, we recommend a monitoring approach whereby EU institutions follow ongoing piloting activities and related research initiatives as a means to stay informed of best practices. A further recommendation is to monitor initiatives such as the ODIN project, as this type of data sharing is part of their future research agenda.

**5. Allow for further trials and experimentation before legislating on open ticketing protocols**

For a number of years, commercial MaaS operators have been advocating the deployment of open ticketing protocols (open APIs) within public transportation, to facilitate a carte blanche for service development. If such standards were implemented across member states, significant barriers to commercialisation and scaling would be removed, allowing MaaS operators to develop and implement services across jurisdictions in a free and open manner. However, open ticketing protocols could also potentially open the floodgates for multinational players to access European mobility markets, potentially to the detriment of European innovators and entrepreneurs, many of which are start-up companies who see MaaS as a significant business and innovation opportunity. Moreover, commercial MaaS actors are not alone in fearing the prospect of global players such as Google, Apple and Uber assuming dominant positions within the MaaS market. Public actors are also fearful of such developments, as they wish to retain a level of control over local developments, steer local mobility systems towards more sustainable outcomes and ensure that local transport service providers

do not become white-label suppliers to multinational entities. Hence standards for third-party resales of individual transport services, particularly regarding public transportation, are not advisable at this point. Rather, it is imperative that local initiatives continue to trial and experiment with MaaS and that public and private actors are afforded protected spaces within which to establish their roles, competences and market positions prior to any legislative decisions on open ticketing protocols.

**6. Provide member state level mandates regarding the role of public transportation within MaaS developments**

A common challenge among the IMOVE living labs (and in relation to MaaS piloting activities elsewhere) is the functional fragmentation of existing transportation services and the inherent threats of collaborating on the development of an integrated system. Given the financial and institutional contours of existing mobility systems, actors have no natural reason to cooperate with one another, and every reason to optimise solutions for their respective services. In particular, the IMOVE project demonstrates the centrality of public transportation to MaaS developments, and the capacity for public transport authorities and operators to implement “make or break” decisions. In Turin, this is apparent in the initial reluctance of the PTO to collaborate with a MaaS scheme led by the municipal authorities and a third-party integrator. In Manchester it is illustrated by the presence of a multitude of specialised bus operators that are unwilling to risk losing clientele in a MaaS scenario. In Berlin, it is evident in both the PTA’s decision to develop its own MaaS solution (separate from URBI’s attempts), and in URBI’s challenges integrating different payment and ticketing criteria of different transportation services into a single subscription. In Gothenburg this is evidenced by a series of perceived risks associated with ecosystem collaboration, and the role of public transport in dictating many of the terms associated to local MaaS developments.

In order for MaaS to progress beyond a phase of experimentation characterised by pilots and trials, into a phase of commercialisation and scaling, public transport must be given clear mandates to support one of three approaches to developing MaaS (market-driven, publicly-controlled and public-private approaches). At this stage, it is not clear which of these approaches is most beneficial, such that policy must allow for developments along all three pathways. However, it is paramount that public transportation does not continue to impede MaaS developments by deferring action due to the need to consider their own role within MaaS ecosystems. Hence we advocate policies at the EU level that encourage member states to decide on national approaches to MaaS developments according to the following:

- In order to facilitate market-driven approaches, political directives that facilitate third-party sales of public transport are likely a necessity. The responsibility for issuing such directives varies according to the institutional arrangements that govern public transportation in any given city and may fall onto the PTA, city councils, municipal authorities or regional/national governmental bodies.
- In order to facilitate publicly-controlled and public-private approaches, public transport operators must be given clear mandates to adopt the role as MaaS provider within the MaaS ecosystem. In some member states this is perceived as a politically feasible approach whereas in others it is not, due to interpretations of national and EU regulations on the role and mandate of public transport authorities and operators. Hence in some cases, action from national governments may be required to facilitate such an approach.

Given divergent interpretations of existing legislation across member states, the EU can further intervene by revisiting and reformulating existing directives that define the role and mandate of public transport authorities and operators, and by specifying whether or not publicly-controlled approaches to MaaS developments align with European legislation.

**7. Encourage local authorities and county governments to collaborate on MaaS developments**

Generally, government organisations at the county, city and municipal levels have hitherto not been strongly engaged in formal discussions and debates about MaaS developments, even in countries such as Sweden and Finland which are regarded as pioneers of the concept. There is a general lack of knowledge and awareness of the MaaS concept within these types of public organisations. Further, there is a problem related to the way in which authorities are currently set up to govern, in that policymaking at the local and county level is often referred to as fragmented and occurring within silos. Practically, MaaS developments have implications for and are influenced by local transport policies, urban planning, public transportation directives and local sustainability objectives. It is paramount that public actors at the local and county levels collaborate across policy areas with respect to MaaS developments, and seek to ensure that MaaS contributes to urban development, improved accessibility and access to transport, more attractive cities, more efficient land use, etc. To this end, we recommend that the EU supports the creation of collaborative working groups that seek to join forces and merge policy initiatives at the local and county levels, in a manner that overcomes fragmentation and serves to integrate policy making in a holistic manner. In practice, MaaS is likely one of many transport-related areas that would benefit from such an approach to local policy making and agenda setting.

#### **8. Harmonise taxation laws and establish legal frameworks for different types of transport service providers**

MaaS aspires to provide an alternative to private car ownership and use. It is this objective that reflects the appeal of MaaS vis-à-vis the fulfilment of transport policy goals and broader sustainability objectives. MaaS aims to reduce travellers' dependency on private cars by promoting modal shifts and the use of shared and active modes via the integration of different transport services. In some European member states, however, there are differing levels of value added tax for different transport services such as taxis, car clubs and public transport, creating an uneven playing field for individual mobility service providers. The EU can support MaaS by creating a more level playing field among transport providers via the harmonisation of VAT legislation.

Further, while the inclusion of peer-to-peer (P2P) mobility services in urban MaaS initiatives has not yet taken off, it is a hotly discussed topic among MaaS practitioners. Across member states, however, income tax laws related to shared services such as P2P mobility are highly divergent. In Finland, for example, the national government has sought to incentivise the development of shared mobility services by offering tax exemptions below certain levels of income. This is not the case in other member states. If the harmonisation of taxation laws for shared mobility services is not desirable and/or politically feasible, the EU should nonetheless outline policies that encourage member states to incentivise vehicle sharing schemes given their potential to reduce transport emissions and alleviate congestion.

Finally, the mobility market is fast-moving, with new mobility services (e.g. free-floating electric kickbike services) rapidly appearing across European cities. It is paramount that legislative and particularly legal frameworks keep pace with the introduction of new mobility services, so as not to hinder their diffusion and potential integration within MaaS systems. In Sweden, for example, there is currently no legal definition of services linked to car sharing, which makes it difficult for these types of car sharing services to scale, regardless of their integration into MaaS schemes. It is thus paramount that the EU encourages member states to institute the requisite legal frameworks that provide new mobility services with a licence to operate in judicial terms.

#### **9. Incentivise the development and adoption of MaaS via suitable policy instruments**

MaaS operators, particularly those which comprise entrepreneurial start-ups, face a significant challenge in developing financially viable business models. In short, it is difficult to make money from MaaS, particularly in the early phases of development and diffusion. Within the MaaS field, a number of policy instruments are discussed as a means to promote the development and diffusion of MaaS innovations, and their uptake among

users. These include, the redistribution of state subsidies for public transportation; exemptions from congestion charging; tax exemptions for MaaS services deployed within employer-based travel; exemptions from fuel taxations; allowances for shared vehicles in bus lanes; incentives and reward schemes; and so on. At present, given the immaturity of MaaS developments, there is a lack of knowledge regarding an appropriate mix of policy instruments that can boost the development and diffusion of MaaS. As such, public officials within some member states have started to discuss and implement experiments and trials of policy instruments using the rubric “policy labs”. This is a fruitful approach that should be deployed across member states, and can support future governance initiatives and policy innovations. Hence, we recommend that the EU encourages and supports member states in experimenting with different types of policy instruments in different geographical and cultural contexts. From an EU perspective, monitoring policy innovations is paramount prior to any legislative acts.

Moreover, there is uncertainty as to whether public procurement can support innovation within the MaaS field. However, MaaS does not currently exist as a service category within procurement criteria in the public sector within the majority of member states. Clarification of the rules related to public procurement and organisational learning are essential to the mobilisation of public funds as a support to MaaS developments via procurement activities.

Despite the uncertainties related to the types of policy instruments listed above, there are three areas in which member states (and jurisdictions therein) can enact policies that can provide direct support to MaaS developments. First, parking regulations have been proven to be a useful mechanism in promoting both the development and deployment of MaaS in urban areas. In Sweden, several R&I projects that centre on newly built urban areas have experimented with replacing parking infrastructure with mobility services, both in terms of residences and workplaces. One of the IMOVE pilots in Gothenburg consists of a newly built residential area with no traditional on-site parking, and the reduction of the so-called “parking norm” (a regulation stipulating the number of parking spaces per residential dwelling) is commonly understood as a powerful means to support the deployment and adoption of mobility services, including MaaS. The EU should encourage member states to follow similar paths by enforcing newly constructed buildings to avoid constructing parking infrastructure, especially given the opportunity to significantly reduce costs (a single parking space can cost up to €50,000). Consideration should also be given ways in which existing parking infrastructure can be converted to other land uses, particularly in densely populated areas such as cities. The latter is however a complex issue due to revenues generated from parking fees, and this must be acknowledged and handled with care in any interventions in this area.

Second, MaaS, as an integrated multimodal service offering, requires a similar level of integration with regard to physical infrastructures. That is, existing transportation nodes must be transformed into multimodal mobility hubs whereby travellers can access a multitude of transport-related services. In practice, a mobility hub co-locates public transportation, taxis, car and bicycle sharing services in order to facilitate transfers and modal shifts within a single journey, and may also provide the opportunity for travellers to park and ride when travelling into cities from peri-urban areas. The co-location of additional services such as grocery deliveries may further encourage travellers to switch modes and adopt more sustainable travel behaviours. The EU can intervene by encouraging local transport planners and managers to cooperate with city planners and urban developers to explore ways in which co-location via mobility hubs can support MaaS developments and encourage multimodal travel.

Third, barriers to the scaling of individual mobility services such as car sharing clubs must be removed given their importance to MaaS developments. At present, in some member states car clubs are faced with cumbersome administrative burdens linked to the location of parking spaces and the introduction of vehicle recharging when introducing new cars to their fleets within urban areas. Some European cities, such as Helsinki, have provided ample parking infrastructure for shared vehicles, whereas others have not. Hence, we

recommend that European cities and municipalities are encouraged to allocate parking infrastructure shared vehicles. Further, we recommend that cities and municipalities procure licenses with partners who can to install electric vehicle recharging infrastructure for shared vehicle fleets according to streamlined procedures that avoid current levels of administrative bureaucracy.

## CONCLUSIONS

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Experimenting with and trialling the MaaS concept in real-world settings across different European cities reveals a rich diversity in terms of the approaches adopted, piloted services, and in terms of the drivers and barriers of MaaS developments. Presently, a majority of factors which influence MaaS innovations issue from a meso level of local MaaS ecosystems that encompasses different types of mobility service providers and local stakeholders with a critical interest in MaaS. Whilst considerable efforts are required to overcome barriers to ecosystem collaboration and mobility integration via MaaS, it is important that the user-centric ethos that demarcates MaaS from other efforts to reform transport systems is not forgotten.

The current (un)sustainability of passenger transportation systems is centred on dominant travel practices, whereby two dominant paradigms roughly characterised as shared vs. private travel (i.e. public transportation and other shared modes vs. individual car-based travel) have, until recently, evolved in a separate and fragmented fashion. MaaS comprises a wonderful opportunity to consolidate mobility within cities and redefine public transportation and car-based travel according to the principles of the sharing economy and sustainable development. On this point, it is paramount that on-the-ground MaaS developments serve to marry a user-centric approach with ecological (and social) sustainability gains. This is important given the salience of environmental problems such as climate change and the need for affordable, accessible transport solutions, but also from a practical perspective. That is, MaaS schemes that do not successfully attract users from the existing car-ownership segment will likely fail to overcome the barriers to ecosystem collaboration identified in this report. Without these users, service providers will compete for existing customers, risking cannibalisation of their offers, and they will fail to reach new customers and markets. This provides additional impetus for a user-centric approach that seeks to resolve problems for and fulfil the needs of travellers in the private car segment via compelling MaaS solutions.

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