MOBILITY AS A SERVICE- MAAS

Describing the framework

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[Image of VinnoVA logo]
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Report background

This document report results and reflections from a series of workshops and collaborative meetings in the project, conducted during Q3 and Q4 2015. The sources this report is based on, the UbiGo case, results and work conducted in Finland by VTT and University of Tampere, work done in the MaaSterplan project (Vinnova) and other research collaboration with Chalmers Göteborg, SMART Mobility (University of Michigan), AustriaTech, provides of course a whole range of limitations such as limited geographical coverage, limited study time, limited volume of users and so forth. This is a typical situation for pre-studies and for single-case studies and should hence be taken into consideration when reading the report.

Nevertheless, this type of research method is a suitable choice when researching new phenomena, like MaaS. Such an approach contributes significantly to the development of a research agenda for the new phenomena - MaaS in this case.

Even though the results and reflections are based on few, even single-case studies, this early scanning for “important and crucial factors for MaaS” identify factors that have a high probability for being relevant more broadly for the MaaS phenomena. A handful of pre-studies like this one are probably quite sufficient to create a relatively comprehensive research agenda for MaaS for the coming years. Therefore, we end this report by suggesting areas we believe are suitable for future research.
Summary

Mobility as a Service is a quite novel term and has not a commonly agreed definition yet. In this report we use the term Combined mobility services to describe a service offering, including public transport in combination with other transport modes such as taxi, car-sharing, bike-sharing etc.

The drivers for the change in how we will consume mobility are multiple, but the report discusses Societal trends such as Urbanisation ad climate change and sharing economy, Economical trends such as excess capacity and new payment systems together with technological development as enabler for the transition.

New mobility services are constantly entering the market, and one of the most well-known is UBER. The limousine brokering service that, based on a technological platform have expanded around the world and also in terms of the service offering, now offering services covering the taxi-segment and now starting to offer services very close to public transport.

The auto-makers are starting to grasp a possible different future, and are launching mobility services such as car-pool, free-floating car-pools and simplified car-owning schemes.

Especially in the Nordic countries, the concept of MaaS is taking off, with services like Ubigo, which was piloted in Goteborg during 2014 and MaaS.fi, a Finnish MaaS-service to be started in 2016 in Finland with the goal of a global expansion. Telecom actors like Ericsson and Sonera are also active in this area. In Sweden, the public transport sector is analysing which role they should take in the MaaS-actor-ecosystem, and in Västra Götaland, a pre-commercial procurement of combined mobility services is scheduled for 2016. On a European level, the MaaS-alliance, supported by ERTICO1, was formed during 2015 with the aim to stimulate the implementation of MaaS in Europe. EU also supports the concept by issuing a specific topic for MaaS in the 2016 H2020 mobility call.

There are also a series of research-project ongoing, especially in Sweden and Finland, studying MaaS from a institutional, business and technical perspective. However, few studies are currently researching the sustainability effects of MaaS, even though initial studies indicates that MaaS, if designed bad, also can have negative environmental effects.

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1 European network for ITS deployment. www.ertico.com
Mobility as a Service can be designed in different ways and with different types of actors as the lead. If the public transport should be the coordinator of MaaS or a facilitating collaborator is discussed in the report. The report argues that public transport can provide a better stability of such a service (compared to a commercial MaaS operator), but also that public transport do not have the same flexibility in service offering as an external actor, and that they may attract more public transport users than car-owners to the service, in which case the environmental effects can be negative. The report also argues that if MaaS-service is subsidized (other than the services provided by PT), it can also lead to negative rebound effects, and if it is NOT subsidized, there are less reasons why public transport should organise the MaaS-service.

UITP, the international organisation for public transport, have an active process for combined mobility services, CMS,(as MaaS is named in the PT sector) and promotes PT to take an active or even leading role in the establishment of this.

In the report, some models are introduced for describing different types of mobility services emerging, and the most important distinction of what the report describes as MaaS, is that a **Combined Mobility Service** provides a subscription of some kind and possibly also a re-packaging of included services, while **integrated public transport** mainly gives the user the possibility to plan, book, and pay for the whole journey with several transport modes in one service (app). CMS is therefore both a business model and a technical platform which draws its profitability on the reduction of privately owned cars, whilst integrated public transport represents mainly a technical integration which mainly simplifies the shift between modes for a single trip. Both these versions are often referred as MaaS-services.

The eco-system of MaaS, and different actor roles are introduced in the report, showing that there are business opportunities for Maas-operators, platform providers, mobility service providers as well as for public transport if the MaaS-service is designed in a right way.

Several institutional barriers are identified in the report, which if addressed, could facilitate a faster introduction of MaaS. The Swedish transport subsidy system is discussed, where subsidizing of cars is allowed, but not the subsidizing of mobility
services. The role of public transport and the importance of PT (brand) facing the customer, or if a neutral actor is better in attracting private car-owners to exchange the car for mobility services. The technical maturity of public transport is addressed, while a digitized business process (buying, paying and distributing electronic tickets) is a prerequisite for a commercial MaaS-operator to be able to include public transport in the service offering. Technically, Swedish public transport has a very good position through the work done at X2AB/Samtrafiken, but the policy issues around the possibility for third-party actors to use this, is not yet addressed, especially not on a national level.

Finally several areas are identified where more research is needed to fully understand and take advantage of the possibilities with MaaS. The foremost area, where few initiatives have been identified, is the sustainability effects of MaaS. If wrongly designed, MaaS can give environmental effects of the service are negative (e.g making PT users to use more car-pools), and positive effects are gained if citizens are exchanging the owning of a car with subscription of mobility services.

Other identified research areas are social factors like accessibility are effected by less car-ownership and the introduction of MaaS, how MaaS can contribute to resource efficiency, how MaaS can be supported by policy integration and other institutional issues.

Explaining the MaaS concept

Overview

This report will not attempt to give a clear definition of the term Mobility as a Service (MaaS), even though this is one of the more frequent questions that we encounter in our work. The reason for this is that MaaS is a relatively new concept, and by making a premature delimitation of MaaS, we believe this, in this stage, could hamper the evolution of innovative mobility services. However, we will describe the concept in a broad manner, showing contemporary approaches and perspectives on the term MaaS, and thereby giving the reader an understanding of this emerging trend in the transport sector.

This chapter will initially describe some of the trends in society that can indicate why these types of services are emerging now, and what prerequisites that are in place that
can motivate new business in a traditionally conservative industry as well as behavioural change and new travel-patterns where this traditionally is very hard to accomplish. By giving some examples of emerging mobility services which are gaining either market share or international interest, we will try to describe similarities and also how they differ from each other, and by that building an understanding of the MaaS concept.

Further on in the document we will focus on what we see as a subset of Mobility as a Service – Combined Mobility Services (CMS) which is a more strict description of a service offering containing several transport modes offered in one subscription/service offering to the customer. CMS is the equivalent of what is in Finland and by ERTICO is described as Mobility as a Service.
Background

When the business model of Combined Mobility Services was explored in the Vinnova-funded project (Den Flexible Trafikanten, Arby et al. 2011), and later piloted in the GOSMART project (Vinnova), the term Mobility as a Service was not yet invented. However the recent focus on MaaS as one of the promising tools for decarbonisation of the transport system², is followed by several research projects, pilot initiatives in mainly in the Nordic countries, but also in Europe.

Understanding the context

According to Atkins (2014), Mobility as a Service is one of the main disruptions occurring in the transport sector. This disruption comes in line with the introduction of new socio-economic systems such as the Sharing and Collaborative economy, where access over ownership, on-demand services and decentralization are blurring the distinction between public and private transport.

There are many drivers and enablers for MaaS, however there are a lack of scientific literature on the identification of these. This report will attempt to give summary to the drivers identified in currently available literature, professional experience and workshops in the topic. The drivers have been classified into societal, economical and technological.

Societal

Urbanisation and densification

The urbanisation is an ongoing trend in the world. In Urban Europe Strategic Research and Innovation Agenda (2015:9) they note that:

“Some 73% of the European population was considered urbanized in 2010. In contrast with for example Asia and South America, Europe has relatively few cities with more than 1M inhabitants and a relatively high number of small and medium sized cities (SMCs). The larger urban areas are also mainly formed of amalgamated SMCs. “

² Expressed in the Keynote speech of ITS World Congress 2016, Bordeaux
Urbanisation is also visible in Sweden. People increasingly move to cities, which leads to more congestion, but has also resulted in a more acute focus on land use, ‘attractive’ urban development and sustainability in urban planning. The response from many cities is to reallocate urban space from parking places and road lanes to allow for higher population densities with more houses, workplaces and open spaces. For real estate developers, it can often be more cost efficient to enable mobility services rather than building parking places on valuable land. At the same time, cities offer the critical user mass within close proximity for transport assets to be shared and accessed.

**Climate Change**

Tackling Climate Change has put growing attention to public transport, fuel efficiency and alternatives as well as active travel modes (e.g. cycling and walking) (Atkins, 2014). Higher number of users per transport asset may mean there’s less resource extraction and waste production. A MaaS service designed in the wrong way, may also give negative environmental effects (see section Institutional barriers) while a consciously designed MaaS can lower Co2 emissions and through the higher utilization rate of vehicles provide for easier technology shifts to more environmental friendly technologies.

**Millennials and the sharing economy**

A further trend is the emergence of the sharing economy. By harnessing collaborative modes of production and consumption, the sharing economy is currently challenging dominant logics within the field of transport following the success of AirBnB, crowdfunding, the maker movement and numerous applications in the field of transport itself (e.g. peer-to-peer vehicle sharing, vehicle pools and ride-sharing). As regards freight, potentially disruptive services like Shippies, Amazon Flex, Uber Rush and MyWays will likely grow in the near future. These services rely on crowdsourced deliveries via individuals that deliver packages to other individuals or retailers, enabled by smartphone apps.

Another societal driving force includes the Millennials, a generation characterized by declining consumption patterns, having higher flexible working patterns and increase demand for personalised and on-demand services.
A desire for community building can be one of the reasons why there is an increase in peer-to-peer offers seen within transport, however there are also critics of the sharing economy. For example Tom Slee argues in his book “What’s yours is mine” (2016), that the so-called sharing economy damages development, extends harsh free-market practices into previously protected areas of our lives, and presents the opportunity for a few people to make fortunes by damaging communities and pushing vulnerable individuals to take on unsustainable risk.

**Economical**

**Monetize excess or idle inventory**

The main economic driver is excess capacity and idle transport assets. The transport sector is mainly composed of expensive physical assets (e.g. buses, cars, parking spots). The sharing of these tangible assets in the form of car sharing is the most well developed area of MaaS in Sweden. On average, a Swedish car is parked 95% of the time and has an average occupancy of 1.5 people/car (Felländer et al., 2015). With a proper platform this asset currently in excess can be made available in areas where it is in scarcity and therefore creating a profit from it (e.g. for someone who doesn’t own a car that would like to perform a trip during it’s idle time) (Chase, 2015). This is why MaaS services started appearing during the financial crisis as a way of individuals to make a profit from excess capacity.

**Increase financial flexibility**

The majority of the existing innovations for MaaS, and the Sharing Economy in general, are from start-ups. Ease of funding and less entry barriers for start-ups is diversifying the business offer of the transport sector (Chase, 2015; Torben, 2013). Crowd financing also means that the services developed have an existing demand with potential users.

Digital payment solutions (e.g. Klarna, Swish, iZettle) make it easier to make financial transactions, both over the Internet and directly between individuals. Similarly, third party platforms are responsible for the liability of a sharing transaction between two unknown individuals. This has increased people’s positive attitudes towards online payments and reduced risk-averse attitudes towards sharing expensive assets.
**Technological**

**Mobile devices and platforms**

The increased penetration of smartphones and access to Internet is considered as the main enabler of this transformation of the transport sector towards what is known as Intelligent Mobility (Felländer et al., 2015). Many of these new services could not exist without ICT and big data analytics that allow understanding of behaviour and performance patterns, giving predictive power to develop the new MaaS services.

Platforms are the online systems that enable the servification of transport. Robin Chase (2015) postulates that platforms are essential for peers (users) to participate and exploit the excess capacity in transport. Platforms can aggregate individual assets in order to create enough consistency and reliability for the users. With a certain degree of standardization (e.g. billing and user information), platforms can be easily replicated and new applications found.

**Social networking – Social profiles and reputations tracking**

Social networking not only provides a way of marketing a new MaaS service, it also means that both the service provider and the user can be rated. This dynamic rating demands that the service be constantly improved and evolve to meet user demand.
The MaaS world around us

Emerging mobility services relating to MaaS

Perhaps the most globally known mobility service today is Uber, the mobile app and platform that allows users to submit a trip request that is then routed to Uber drivers who use their own cars. Uber was founded as peer-to-peer taxi service in 2009, added carpooling features in 2014 and by 2015 many US cities integrated it with public transport as last mile solutions to and from buses and train stops (Jaffe, 2015; Uber, 2015). By adding new features to the Uber-concept, they evolve towards a more complex service offering, and could eventually be described as a MaaS-operator (Taxi-pooling; Uber Pool; Ridesharing; Uber Pop; Dynamic route based transport with fixed stops; Uber Hop)

A growing interest from the Auto-makers (OEM´s) for mobility services are also indicating a shift in how mobility will be offered in the future, Examples on this are AUDI Unite (possibility for a group of individuals to lease a car including a sharing service), Car2Go (Daimler offering a free-floating car pool for cities); DriveNow (BMW offering a free-floating car pool for cities) Ford Smart Mobility (Ford launching 25 global wide experiments for testing new innovative mobility services), Volvo Cars (Sunfleet car-pooling services in Sweden). The interest from the automotive industry is both understandable and crucial, since new business models are needed for these companies if and when mobility shifts from ownership of transport services towards consuming mobility services.

However, as we will explore further on in this document, MaaS is a currently an evolving concept with new services constantly being added. Types of services that can be relevant to complement MaaS are non-traditional personal transport services. New and innovative delivery services such as grocery deliveries to your home can substitute a shopping trip. Similarly, use of collaboration platforms for performing tasks like dog walking or picking kids from school can also substitute car trips. Annex 1 contains a list of MaaS related services available in Sweden.
MaaS services in Sweden, Finland and Europe

Sweden

In Sweden, the first MaaS operator was piloted before the term MaaS was defined. In the Vinnova financed project, GOSMART (see below), the concept was tested for the first time. Vinnova have continued supporting research and innovation in the area through its cooperation with TEKES and by supporting the innovation procurement in the region of Västra Götaland (see below). The role of public transport in relation to entrepreneurial MaaS-operators has not yet been clearly established (see 4.1).

UbiGo (UbiGo innovations AB)

UbiGo is a Swedish SME formed as the result of the Vinnova financed GOSMART project (Vinnova 2012-2014). In GOSMART a fictive company was formed, trying the business model for a MaaS operator with paying customers under real commercial conditions. The business model was developed in a Vinnova-financed project “Den flexible trafikanten” (Arby et al, 2011). After the end of GOSMART-project a group of individuals from the project started UbiGo AB, with the purpose of continuing the service with existing customer base, expanding it into a full service. Challenges with raising start-up capital for financing the technical platform and uncertainty about public transport support for the service, resulted in the closing of UbiGo AB, and the starting of UbiGo Innovations, with the purpose of refining the concept, seeking ways to restart the concept.

In December 2015, UbiGo Innovations and Ericsson AB announced cooperation, based on Ericsson providing the technical platform, and UbiGo Innovations providing the business concept. A first service in Sweden based on this collaboration is planned for spring 2016.

Public procurement of Combined Mobility Services at Västrafik - Sweden (Public transport of Västra Götaland)

Following the GOSMART project and the UbiGo pilot, of which Västrafik was a part of, Västrafik, conducted a pre-study exploring how this new form of services could be utilized in the region of Västra Götaland. The pre-study resulted in the recommendation, and later on, a political decision (Västra Götalandsregionen, KTN 62-2014) to “stimulate the market enabling a company to provide a combined mobility service closely connected to the Västrafik brand”. Västrafik plans to initiate a
procurement process for this during 2016. The design of this process is at the writing of this report, still ongoing, but models of pre-commercial procurement and concession-based procurement have been discussed.

**Ericsson AB - MaaS platform**

Ericsson has through its cooperation with UbiGo and Viktoria Swedish ICT developed a pilot platform for offering a MaaS-platform to MaaS-operators (hence becoming a MaaS platform provider). This means that Ericsson can provide the technical platform (including back office services) as a service to MaaS providers. This reduces an obstacle for small enterprises, not needing to start by developing heavy IT infrastructures for offering a MaaS service.

**Samtrafiken - Platform for combined mobility services**

Samtrafiken ([www.samtrafiken.se](http://www.samtrafiken.se)) is hosting an arena that will enable the dissemination of all the knowledge accumulated in the VGR / Västrafik process regarding combined mobility services. The work is also expected to lead to the conclusion that the conditions to be able to offer combined mobility solutions through national cooperation is clarified. Among other things, the following issues need addressed

- how can the combined mobility solutions be organized and provided through own and / or third party channels?
- how can public transport cooperate with other players outside the public sector?

The work also includes anchoring and probes the interest of the parties nationally and assists in the process of preparing joint innovation procurement.

**Finland**

Since the 2014 ITS Europe conference in Helsinki, when the host ITS Finland, launched the MaaS-concept as describing an entity offering a mobility package as a subscription service, Finland have invested time and research funding in the concept. The Finnish innovation agency, TEKES, launched during 2015 a program aiming to stimulate the start-up of services through seed-financing of pilots and pre-studies. ITS-Finland has been one of the driving forces behind the starting of the ERTICO-backed MaaS-Alliance.
MaaS.fi
In Finland, a group of eight investors lead by Transdev (Veolia), have teamed up forming a MaaS operator. Maas.fi intends to launch a service in Finland during 2016 offering a subscription of various transport modes under one contract.

Tuup
Tuup is a Finnish SME that started up a MaaS service targeting initially companies and their business mobility needs. Tuup is creating value for the companies through simplified administration of mobility costs, and at the same time allows for the employees to use the service for private mobility which creates dual incentives for the employer to use it. Employers pay for a third of their employee’s travel costs. Tuup allows separate payment of work-related and private trips and digitizes travel receipts and reports.

Sonera MaaS services
The analogy between the mobile phone subscription and the subscribing of mobility services are frequently being referenced when studying MaaS services or MaaS entrepreneurs. Even though there are differences between mobile phone services and mobility services when it comes to marginal costs of the actual service, the supporting infrastructures developed by the telecom industries (billing, transaction handling, subscription handling) have been seen as a possible component when developing MaaS services.

One of the telecom actors, which have announced its presence in the Maas domain is Finnish based Sonera, who have developed a conceptual MaaS-service that will be piloted early 2016 in Finland.
“We will pilot our MaaS service in spring 2016 together with several partners, for example Finland’s national railway operator VR, several cities and regional traffic operators, as well as the Finnish Taxi Owners’ Federation. After a three-month pilot period, we will decide about further development and commercial launch, which will hopefully take place during 2016.”

Snowbox.fi – MaaS in Ylläs Holiday resort

A project aiming to provide packaged mobility services in the Ylläs holiday resort, enabling the holiday without the private car. A part of the Aurora program,

Figure 1 MaaS development timeline in Nordic countries

Examples of research activities in the Nordics and other European countries relating to MaaS

The table below does not claim to be a complete list of research in the area, since initiatives are started in a quick pace. However, most research initiatives in this area are identified in Sweden and Finland which corresponds to the identified projects and commercial activities listed above. AustriaTech are closely following the emerging trends, but have not identified any specific research projects in the Austrian academia targeting mobility as a service.
## European initiatives to stimulate MaaS

### The MaaS Alliance

During the ITS World Congress in Bordeaux in October 2015, the MaaS alliance was formed by 20 collaborating organisations joining forces to work towards a common European approach to MaaS. At the inauguration, the alliance was supported by Aalborg University, AustriaTech, Ericsson, ERTICO – ITS Europe, Federation

**EU Horizon 2020**

In the 2016 H2020 call, one special topic, MG-6.1 Innovative concepts, systems and services towards ‘mobility as a service’, is launched to stimulate European development towards MaaS with a total budget of 25 MEUR.
Models for characterisation of mobility services

The notion Mobility as a service (MaaS) is still quite novel and lacks a clear definition. It is not easy to discern which services fall into this concept. Some include services like Uber in the MaaS definition. Others include extended travel planners while yet others claim that MaaS is equal to a combined mobility service (CMS), i.e. that MaaS provides a mobility service based on a platform of multiple and different modal services like public transport, taxi, car sharing, bike sharing etc.

Strictly interpreted, MaaS has existed since the dawn of mankind, but a crucial enabler of more widespread consumption of MaaS is the digitization of society, the diffusion of smartphones, the possibility to stay connected 24/7, GPS tracking, and the dramatic reduction of IT-, transaction-, and sensor costs. Now is the time when individual mobility needs can easily and immediately be communicated and met through customized mobility offerings built from combinations of underlying and often standardized mobility services.

The lack of a clear definition of MaaS may be good at this point since we are in a transition time where a definition one week may become obsolete the next. The current innovativeness level in the MaaS domain is high and actors and roles grow and change almost on a daily basis. To avoid lock in effects of a definition, we propose mapping out the services and categorizing them into the two models discussed in the following sections.

Different levels of MaaS

The first model organizes MaaS examples based on their complexity and innovativeness.

It begins with simplified car ownership, in which OEMs offer their customers the possibility to own a vehicle together with other users. Audi Unite for example, calculates ownership and running costs between co-owners based on the time each
uses the car. Similarly, BMW i lend their electric vehicle owners a complementary conventional fuel car if the destination cannot be reached within the electric range.

Figure 2 Different levels of MaaS

Uber is the most common MaaS service and is the prime example of peers transport service category. This type of services leverage excess capacity (idle cars or empty car seats during a trip) and shares it between users. The MaaS provider does not own vehicles under this category; they only provide the platform that makes the pairing possible.

Car sharing is the most developed MaaS category in Sweden. Unlike the previous category, an organization (profit or non-profit) owns both the vehicles and the enabling platform. These services are characterized by being more standardized and reliable than peer services. Most OEMs currently have an associated Car-sharing company as an attempt transition into mobility services.

Extended multimodal planners combine all the available transport options with real time transport data in order to help users plan the most efficient route to their destination. Some services can go beyond just planning by allowing you to purchase the necessary tickets for the suggest route.
With Combined mobility services, we mean a neutral third-party, commercial such as UbiGo and MaaS.fi or otherwise, that offer a wide range of combined mobility options and offer it to users based on subscription and unified invoicing, possibly also with some form of repackaging of the included services. CMS is also supported by some form of digital interface for the customer (app, web based service etc).

Similarly, Integrated pubic transport systems such as Helsinki’s Mobility on Demand aim at designing public transport in a way that it can easily integrate other mobility offers (e.g. car sharing, bike sharing, taxis, etc.). In Austria, the SMILE-project 4 2014-2015, aimed to include public transport, urban mobility services and national railway in the same concept offering planning options and ability to book and obtain tickets in the same app (without subscription or packaging). With of 1000 registered users during the pilot in 2015, the turnover of consumed mobility services were significantly lower than for the 70 households in the UbiGo trials. The SMILE-service was though not offered as a subscription, in the same way as in the UbiGo case. Another example is Ha:mo, the Toyota platform that tries to optimize the use of cars and other personal vehicles in combination with public transportation. Similar to the extended multimodal planner, the idea is that you should be able to purchase the best mobility offer for your specific trip based on real time transport data. The main difference is that the level of integration and complementation required must be overseen by a specific organization in order to maintain the quality required to have mobility as a public good.

Finally, the Mobility Broker concept also offers mobility subscriptions but these services go one step further in that mobility is offered as part of the rent. This demands that mobility services be included in the initial planning process of apartment complexes or city areas. The drive for such services is to enable densification of cities without the need of a personal car. There is currently no such offer in Sweden, however the Vinnova financed project “Dencity” aims at delivering a working concept for a Mobility Broker in Frihamnen, Gothenburg.

4 http://smile-einfachmobil.at/pilotbetrieb_en.html
Integration vs Ownership model for categorizing MaaS

The second model tries to exemplify MaaS based on the level of system integration (Y-axis) and ownership (X-axis) of transport assets in the available services. MaaS can lead to the misconception that the personal car is substituted; however, with this model we try to portray that MaaS can include the privately owned car.

![Figure 3 Model for describing MaaS services](Image)

The X-axis shows that MaaS can be enabled both with privately owned assets (e.g. peer transport service Skjutsgrupen) and with publically or company owned assets (e.g. Car sharing Sunfleet). The Y-axis tries to exemplify that MaaS ranges from individual assets (e.g. simplified car ownership Audi Unite) to seamlessly integrating a big number and variety of assets into broader systems level (e.g. Integrated public transport Ha:mo). The Mobility Broker concept can potentially be realized by combining both private and public/company owned assets.
Both models shouldn’t be seen as providing one single measurement unit, they illustrate different services that today may be seen as MaaS but that can easily move and expand to cover more of the MaaS concept. Uber started as a limo service, moved into a taxi role, continued into car sharing and now, with predefined pickup places can be viewed as a public transport alternative. An extended travel planner may gradually expand by including possibilities to buy mobility directly and even further to optimize one’s individual travel and hence becoming a UbiGo like offering. Audi Unite may expand its market and use it for introducing autonomous cars and expand its offering into an Uber-like autonomous offering. In addition, human mobility may be combined with parcels. So, what we face is an exciting and turbulent time filled with innovative initiatives that grow and change the view on what MaaS is or should be.

The following section will predominantly focus on Combined Mobility Services (CMS), i.e. services based on a set of different means to being mobile. CMS, if not being equal to MaaS, is at least an important subset of MaaS. The content in this section builds extensively on findings and insights from the GoSmart and UbiGo projects.
One MaaS ecosystem

Different roles in the MaaS eco-system

A scalable combined mobility service (CMS) will be more or less implausible to materialize within one organization because of the sheer size of the required mobility services. The bigger geographical area to cover, the more implausible it gets. Instead, CMS can be based on a business ecosystem⁵ where multiple actors add services from their existing core businesses into a whole that constitutes the CMS offerings (fig 4).

![Figure 4 MaaS eco-system actors](image_url)

**CMS service provider and CMS service operator (CMSP and CMSO)**

As with many business ecosystems, there needs to be a business ecosystem leader, or the combined offering is unlikely to emerge within a reasonable timeframe and then remain existing. This is the role of the CMS service provider in the picture above (CMSP). The CMS service provider is the one whose core business (objective) is to

⁵ See for example The Wide Lens by Ron Adner.
scale and grow CMS. In order to do so, local CMS operators will be required (CMSO). These operators ensure that the CMS offerings are provided and managed locally, enabling the CMSP to carry on with geographical scaling.

**Mobility service providers (MSP)**

CMSO collaborate with local providers of the actual mobility services, named mobility service providers (MSP) in the picture above. These are typically taxi companies, car sharing companies, bicycle sharing companies and other mobility service providers who can contribute to an attractive solution for customers mobility needs. Public transport (PT) may be seen as one of the mobility service providers, but there are reasons to view PT as a separate actor because of its role.

**Public transport (PT)**

Mobility is a key concern for society. It contributes significantly to society’s prosperity (enabling workforce mobility and commercial exchange of goods and services) but also to challenging negative externalities (congestion, accidents, emissions, etc.). Among the many tasks for the public sector, one is to manage negative externalities from commercial markets. The negative externalities from personal mobility in cities may be of such magnitude that the public sector finds reasons to provide for public transport in order to reduce some of these externalities. If the ticket price for such transport exceeds customers’ willingness to pay for the travel, which often is the case, subsidies may be required in order to get public transport used. Public transport becomes a *merit good*.

The concept of a *merit good* introduced in economics by Richard Musgrave (1957, 1959) is a commodity, which is judged that an individual or society should have on the basis of some concept of need, rather than ability and willingness to pay. Another perspective on merit goods is based on negative externalities, an unwillingness or difficulty to internalize them, and on consumers’ potential lack of information, i.e. they act from bounded rationality. In some cases consumers do not perceive quite how good or bad the good is for them: either they do not have the right information, lack relevant information or face ‘the tragedy of the commons’ (Hardin, 1968). With this perspective, a merit good is defined as good that is better for a person than the person

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6 [https://en.wikipedia.org/wiki/Merit_good](https://en.wikipedia.org/wiki/Merit_good)

who may consume the good realizes (and hence is willing to pay for). The merit good has a cost that is higher than its consumers are willing to pay. Without intervention, the good will not be consumed but instead an alternative that generates more negative externalities will be consumed.

Public transport in a city can be better for consumers than other alternatives, for instance due to the public transport’s reduction of congestion, emissions and other negative externalities compared to f.ex private car use. Public transport, when being a merit good, can’t however exist without subsidies because what consumers are willing to pay privately is too low for commercial interests to make profit from. When the lack of such public transport would generate more mobility inequalities and/or negative externalities than the level of subsidy required, a governmental subsidy can be motivated.

Based on the reasoning above, we have chosen to describe Public Transport as a separate mobility service provider, since it mostly is subsidized, and to include a possible Mobility Manager (the City), since a city, a municipality, a region or a country may have an interest in ensuring that a CMS can exist over time and becomes sustainable from both an economical, a social and an environmental perspective.

**Platform service provider (PSP)**

Mobility needs of individual CMS customers must become known and synchronized with the mobility resources provided by MSPs. Agreed contracts and payments shall be managed, and various situations needs to be managed and optimized. This is handled by a platform service that is provided by a platform service provider (PSP). By introducing the PSP in the eco-system, development cost for the IT-infrastructure can be shared between CMSO’s through a set of competing PSP’s. Commercial PSP’s will most probably also increase the pace for (de-facto) standardization of integration, service roaming and API’s for various MSP’s. In the MaaSterplan project (Vinnova, 2015), one finding was that it is technically and commercially viable to develop and provide a generic CMS service platform, supporting various types of MaaS-services offered by a PSP.
Business models for MaaS actors

For a CMS to materialize, all required actors in its business ecosystem must benefit from its existence, or the CMS will not survive. Mostly, the required set of MSP exists pre-CMS and run their operations in accordance with their individually designed business models\(^8\).

The additional benefits from participating in a CMS don’t necessarily have to be big, but required actors may not suffer because of CMS. This can be evaluated by objectively weighting relative advantages and disadvantages for each required actor in the business ecosystem, Table 1.

<table>
<thead>
<tr>
<th>Actor</th>
<th>Relative advantages</th>
<th>Relative costs</th>
<th>Sum</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMSP</td>
<td>License fees, information aggregation and sale (mobility data), roaming between CMSO</td>
<td>Brand building, methods, concepts etc. license fees to PSP, Business risks, considerable start-up costs</td>
<td>++(+)</td>
<td>Requires endurance</td>
</tr>
<tr>
<td>CMSO</td>
<td>Customer revenues, info.sale, local alternative revenue streams, &quot;owns&quot; the customer base, part of a bigger brand</td>
<td>Franchise costs, start-up costs (?), CMS BM business risks</td>
<td>+++</td>
<td>Initially, the CMSP will be the first CMSO</td>
</tr>
<tr>
<td>MM</td>
<td>Less congestion, lower demand on parking space, possible reduction of other negative externalities</td>
<td>Higher subsidy costs (due to more PT)</td>
<td>++</td>
<td>MM and PT are separated in many places</td>
</tr>
<tr>
<td>PSP</td>
<td>New revenue sources to existing service platforms</td>
<td>Adaptations to the platform</td>
<td>++</td>
<td>Global customers and scalability are prerequisites</td>
</tr>
<tr>
<td>MSP taxi</td>
<td>New customers, shared costs, new use of taxi (new application)</td>
<td>May cannibalise existing customer stock, less customer &quot;ownership&quot;, lower brand value</td>
<td>+</td>
<td>Demands new customers and higher utility rate.</td>
</tr>
<tr>
<td>MSP PT</td>
<td>More travellers through other sales channels</td>
<td>Risk for cannibalization on existing stock of travellers, stronger &quot;counterpart&quot; than individual travellers</td>
<td>++</td>
<td>We assume PT want to have more travellers (which may create higher operational costs)</td>
</tr>
<tr>
<td>MSP car sharing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSP bike sharing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1  CMS eco-system actor analysis

MaaS operator

The business model of the CMSO is described in fig 1 using the Osterwalder Business Model Canvas\(^5\).

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\(^8\) Regarding definition of, and tools for depicting business models, see for example Chesbrough & Rosenbloom (2002), Osterwalder (2004) and Osterwalder & Pigneur (2010).
Figure 5 Business canvas for Combined Mobility Service Operator (Ubigo Innovation AB, 2015)
CMS Service Providers

The business model of the CMSP is described in fig 2 using the Oosterwalder Business Canvas model.

Strategies and approaches for combined mobility services

Public transport view on Maas vs Maas View on public transport.

UITP, the international organisation for public transport, is very much supporting the idea of MaaS (described as Combined mobility Services) and published 2011 a position paper (UITP, 2011) on combined mobility services aiming to guide its members in how they should approach this topic.
Combined mobility, meaning offering integrated mobility services with public transport as a backbone complemented by other modes such as car-sharing, bike-sharing, taxis, cycling and on-demand services is the only mobility solution able to compete with the private car in terms of flexibility, convenience and cost-structure,” - Caroline Cerfontaine, UITP Combined Mobility expert.9

UITP recommends PT to take an active role, or even take lead in the partnerships building the CMS and the possibility of an outside actor taking lead, is even seen as a threat for the industry.

“There are more and more solutions popping up, more and more platforms, new acquisitions, new apps and new websites. The technology wasn’t there before and now it’s being used in inventive new ways. The challenge is that something from outside the sector will act faster than us, and become the leader of the urban mobility market. This threat is very real.”10

To be able to understand which role public transport should take in the emerging MaaS landscape, one has to discuss the mission of a publicly funded PT. One role for the public sector can be to provide mobility on a reasonable level also for those citizens with mobility needs exceeding their ability to pay. This may require subsidized mobility offerings. Another role, previously mentioned, can be to reduce negative externalities from mobility by providing alternatives to those mobility options that creates the negative externalities. For example by providing public transport as an alternative to using cars in cities. If the potential customers’ willingness to pay is less than what commercial operators need to charge, one option is to increase the cost of using cars i.e. internalizing the negative externalities, for example through congestion charges. Another alternative is to reduce the ticket price for public transport, for example by subsidizing its operation.

From a Public Transport (or rather public sector/governmental) perspective, one reason for showing interest in CMS is that it can provide a better and more advanced

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9 http://www.uitp.org/news/maas-finland
mobility service than public transport to citizens with limited ability to pay. Another reason can be that since CMS is a more flexible and more advanced mobility service than public transport, some of those citizens who still judge mobility by car as less “costly”¹¹ than the current public transport offering may consider the CMS offering as more attractive than public transport and less “costly” than using a car. Even though a CMS most likely generate more negative externalities than public transport, it can (should), with an appropriate design, generate less negative externalities than private car use.

By supporting CMS, negative externalities may hence be further reduced at a lower cost for society than other alternatives¹².

If the public sector provides CMS to citizens with a limited ability to pay, i.e. CMS is subsidized to that degree; there is a risk that negative externalities will increase through “rebound effects” in that customer segment of public transport. The argument builds on the fact that CMS is a more flexible, advanced and more attractive mobility service and therefore increases the risk that this customer segment “rebound” from public transport to CMS.

If CMS is designed to compete with privately owned cars, i.e. those who chose to become CMS users will actually sell their cars, CMS can become a more environmentally sustainable alternative if public transport is used for a sufficient share of the CMS services.

MaaS can become both more and less environmentally sustainable than today’s mobility options, which depend on the CMS design. MaaS can both cannibalize and enlarge the current market of existing mobility service providers, including public transport. The public sector may want to design “conditions for license to operate” CMS.

¹¹ “costly” should be read as not only in monetary terms but a car user’s judgement in terms of cost, flexibility, time spent, convenience, comfort and so forth.

¹² One alternative could be to further reduce the ticket price for public transport, but that will have to apply also for current public transport users and will hence be expensive and unnecessary.
Public transport as the coordinator or collaborator in the CMS eco-system

Using the Swedish model for organizing public transport, there are in principle two approaches that public transport can take in the CMS ecosystem. These have been further elaborated in a pre-study performed by Västtrafik (Leveransmodell kombinerad mobilitet. Västtrafik, 2014) and represents alternative 1,2 versus alternative 4,5 in that report.

Public transport as the coordinator of CMS

PT can aim to be the coordinator of the combined mobility service, i.e the CMS operator, and use the already well-known brand to integrate complementary services to support the main service offered – namely the public transport. In this case there will be no room for any commercial CMS-operators other than PT. This service will most probably be hampered by the institutional framework surrounding PT (political decision on fares, service offerings etc), and would by the nature of the political assignment, design the service to maximise use of the existing public transport system, rather than maximising the service satisfaction of the customers (which is not necessarily the same, especially not trying to attract typical car-owners to the service).

Figure 7 PT as the organizer of CMS
The advantages with this model of organising is giving a longitudinal stability (guaranteeing service existence in time) to the service, and lateral coverage (guaranteeing a regional coverage of the service) that is greater than a commercial CMS (see below).

There are though indications, which should be further elaborated, that PT in Sweden under current legislation is not allowed to offer a fully integrated mobility service (one subscription/invoice including private transport modes such as taxi, rental car, car pool etc).

In this model, PT would be the organiser of the CMS platform supporting the integration of the different mobility services, however it could though be supplied by a private CMS-platform provider (PSP) as well as being developed as a proprietary platform.

**Public transport as a collaborator in CMS**

In a model where a neutral (commercial) entity takes the role as the integrator (CMSO), PT would be one mobility service provider among other (even though PT constitutes the service backbone for a CMS service). The CMSO would be driven by a commercial interest and the goal would therefor try to maximise number of subscribers to its service, rather than maximising the use of public transport. From a commercial perspective, the UBIGO trials showed that the earning potential for a CMSO lies in the substantial difference by owning a car compared to a service offering of mobility services, not in transaction-based referral fees. This means that the primary customer base is neither the families that are daily dependant on the car, nor the customers that are well suited with the current offering of public transport. The core customer base lies in the so called “flexi travellers” who can occasionally or often travel by other means than the privately owned car, but also needs other types of mobility services on a regular base.

This customer base will experience a well-functioning CMS service as very priceworthy and a higher willingness to pay for it.
In this setting the CMSO will need to have a high flexibility in re-packaging the included services to be able to provide a tailored service product for the customer, not necessarily the way the CMSP normally offers their services (e.g. “Take public transport to the restaurant, and upon purchase of more than 500 SEK, a bonus taxi will be included for the transport home”).

A private CMSO would most probably not have the same longitudinal stability as with a public CMSP (such as PT), but with a multi-operator approach, there will be a commercial interest of providing the service, and new actors will complement the service (e.g. privately owned companies offering mobile payment for parking). A private CMSO would most probably not have the same lateral coverage as a publicly owned CMSO, since CMS service are most commercially interesting in urban areas. However, by allowing third party CMSO, other types of MaaS services can emerge in rural areas, in cooperation between private and the public (e.g. Broddetorp, A private ride-sharing initiative with a rural focus developed with support by VGR).

The PT role in this model is to provide the CMSO to be able to include the PT services in the CMS offering, with the same subsidies as any other PT user. In practice this would also mean the possibility of offering a digitized ticket in some way that can
be included in the CMS offering. Today this decision lies with the PT, and PT can by owning this decision hinder the starting of a commercial CMSO.

The UbiGo trials also showed the need for a more flexible product assortment, where the “flexible day ticket” significantly lowered the threshold for flexi-travellers to use public transport.

In a Swedish setting, this report have not identified any legal hinders for PT allowing a commercial CMSO to include PT in their offering. By applying a concession based model, a commercial actor would be the re-seller the products that Västrafik is providing today through existing channels (concession based agreements). However, the possibility cannot be given exclusively to one commercial actor, and PT have the possibility to impose concession criteria’s upon the concessioners. For the CMS service to be effective and attractive, PT would need to have the possibility to offer these products electronically (electronic tickets) and with a possibility for a third party to integrate with PT through digital interfaces (API). These preconditions exist already today on a national level (Resplus), but are not available on a regional level.

The UbiGo “Flexible day PT ticket” was a set of tickets valid for one day, priced in relation to the monthly card. 22 individual days of PT for the price of a monthly card. The “Flexible day-ticket” was given a very high rating by the UbiGO users.
Institutional barriers for introducing MaaS

Some important criterias have been observed in the project behind this report.

1. Public transport and/or other shared services must often be the backbone of a CMS if the CMS should be considered *eco-sustainable*. The main reasons are that:
   a. Some MSP will add driving-distance to and from the customer, in addition to driving the customer, i.e. being less eco-sustainable than private car use (for that trip)
   b. Some customers of PT/shared services only will “rebound” from PT to CMS and from time to time use MSP, i.e. being less eco-sustainable than before CMS

2. CMS should aim to be a worthy alternative to private cars for the user. There are at least three arguments for that:
   a. Environmental: The CMB will help reduce negative externalities by reducing private car use and increase the use of the public transport backbone although other mobility services from the CMS will be chosen from time to time based on situational needs and contexts for the CMS customers.
   b. Market: A CMS that replace private cars extends the market for all MSP and PT by bringing in previous car users as new customers and hence clearly enlarge their markets.
   c. Business: There is a considerable difference in marginal cost for an additional mile if one anyhow has to have a car or not. Although the demands on a car-replacing CMS will be much higher than on a car-complementing CMS, the willingness to pay for the service may differ considerably.

3. It is questionable if CMS should be run by the PT actor even though public transport may have to be its backbone (see criteria 1):
   a. If CMS is run by PT, it should not get subsidies “by default” since it isn’t necessarily required and subsidies increase the risk of “rebound” effects from PT-only travelers.
   b. If it isn’t subsidized, i.e. can be run on commercial terms, then why run it by the (subsidized) PT actor?
   c. Instead, the PT actor can contribute to CMS by providing public transport to CMS-like actors in ways that enables various CMS services based on PT as backbone. This may be easier said than done since PT subsidies must not become subsidies to for-profit CMS actors, but running the CMS operation shouldn’t be seen as the solution to that problem.
The subsidizing of public transport

It has been argued that an obstacle for introducing MaaS with a commercial CMSP has been that a commercial entity cannot be allowed to profit from a publicly subsidized public transport. However this concern should not be applicable if the product (ticket) is purchased by the CMSO (with the same subsidy as for any other PT customer) from the PTO (Public Transport Organisers). By seeing the CMSO as any other reseller of the physical ticket this would fall under the same category as concession-based reseller. The very essence is however that a commercial CMSO should make a profit, but this profit would be made from the willingness from the customer to pay a dividend for integrated services, and for other MSP to create incentives for reaching a sales channel to a new customer base. A new EU-directive for service concessions is expected during 2016, which can influence this.

This conclusion is though derived from the current Swedish model where the subsidy is based on the consumption of the PT-service (a Stockholm citizen receives the same subsidiary for a trip in Göteborg as a Göteborg citizen). How PT subsidies are used in other countries or in the future, are something a CMSO needs to take into account in both service offerings and in a technical platform. In Finland, for example, the subsidy is tied to the origin of the traveller, and the Helsinki citizen receives a lower fare in Helsinki than a resident form another Finnish city.

Brand, Image and self-image of public transport

An important source for revenue is the customer, i.e. the consumer of the product/service that is provided. Therefore, the brand, the image of the brand, and a tight connection between one’s brand and the product/service that is provided is crucial for creating customer loyalty and for positioning oneself in the market. The reason for bringing this brand issue to the table is that a CMS business ecosystem incorporates many organizations with established brands, self-interest and brand ambitions.

There are ample examples of brand ambitions that have failed and have succeeded. Two useful examples from the car industry are Volkswagen and Lexus/Toyota. Both Volkswagen and Toyota are volume market brands, which for Volkswagen even are reflected in its name. Both brands wanted to compete also in the premium brand...
segment. Volkswagen began to develop a luxury car, Phaeton, and decided to sell it under the Volkswagen brand while Toyota decided to not only develop a luxury car but to sell it under a completely different brand. So Toyota created, at a considerable cost, the brand Lexus. Lexus has for instance its own dealer and service network completely separated from Toyota.

Toyota has been quite successful with Lexus which today is a respected brand among luxury car consumers while Volkswagen, of course, remains a volume brand. Although Phaeton is a car full of luxury attributes fully comparable to Lexus, Mercedes, BMW and other luxury brands, it is not seen as a car among luxury car consumers and therefore sell in disappointingly small volumes for Volkswagen.

Why tell this story? When it comes to CMS, it may be important for the actors in the CMS ecosystem to understand that their own brands may be unimportant to CMS customers and may even hurt the CMS business. The potential CMS customer groups have hitherto chosen to remain car users for a variety of reasons - flexibility, status, convenience, views and opinions among peers and neighbours etc. The CMS will be offered as a more flexible, individual and “smarter” mobility service than f.ex public transport. Under what brand such an offer is provided can matter a lot and should be a parameter to consider also when designing the CMS offering in terms of pricing, comfort, flexibility, personalization options and so forth.

In the political directive to Västrafik (VGR, Dnr 62-2014), they were instructed to take an approach, alternative 4, where the “control over the Västrafik brand is still high” and with the possibility to influence the quality of the service.

**Tax-legislation for subsidizing commuter-transport**

In a Swedish mobility landscape one cannot exclude the tax-legislation for company subsidized cars (Tjänstebil/ förmånsbil) in the analysis. One of today’s significant lock-in factors for using the “single user car” for commuting to and from work, is the subsidy of the car to the employee. The providing of subsidized car to an employee is considered an advantage in recruiting personnel. Once equipped with the subsidized car, the incentives for occasionally or regularly switching to public transport, is significantly lowered. In the UBIGO project, the enterprise mobility management
processes were targeted as one of the big potential customers for the future UBIGO service. However, due to existing tax regulation, this was seen as a future expansion of the service.

In Finland, the newly started Tuup service is targeting the enterprise segment as primary customer base, offering mobility management for employees, both privately and in the line of work, as their main focus.

By finding a way (tax-legislation) for enterprises to offer mobility services on the same premises as the subsidized car, the market for CMS-services would expand greatly, initiating a significant shift from single user car commuting to more sustainable travel patterns.

**Technical maturity of PT**

As described earlier in this document, one prerequisite of a successful MaaS/CMS service is a well-integrated public transport service. With integrated, we mean both service-wise and technically. The ability from PT to provide a reliable integration to the purchase and distribution of electronic tickets is one of the most important components in this integration. In Sweden there exist today this possibility on a national level, and this have been used in the introduction of “Nationell reseplanerare med köpfunktion “ (X2AB, 2015) which is a part of the portfolio of services provided by Samtrafiken. There are also technical possibilities to integrate with RESPLUS, and by that generate a purchase of a local public transport ticket (resplus). The technical prerequisites are therefore in place; however this is not operationalized on regional level in any of the PTO’s in Sweden.

Sweden can therefore to be said to be well prepared for third party integration, even though work remains for this to be operationalized.

If the local PTO takes responsibility as the CMSO, of course, the integration to the PT ticketing can be made in existing (internal) platforms and tools.
Areas for future research

Sustainability assessment

Both the economical and the environmental advantages of MaaS, is based on the assumption that the owning of cars that are under-utilized, is replaced by mobility services. This is giving room for households to reduce their car ownership, and also by that exchanging some of their mobility from routine usage of the car to more sustainable modes of transport.

This also implies that the primary customer group is the car-user, and not the public transport everyday user. If a MaaS service attracts more PT (core) users, than car (core) users, the sustainability effect can become reduced and even negative.

In the UbiGo trial, analysis supported the fact that the net-effect of the travel was reduced environmental effects, however there were users that changed habits into more car usage (taxi, car-pool). More pilots and live trials are needed to see large scale effects of how different MaaS-designs affect the environmental impact. This topic aligns well with Urban Europe Strategic Research and Innovation Agenda, Theme; Sustainable Transitions Pathways, (Urban Europe, 2015), which states the absence of methods for measuring sustainability.

Social factors

One of the significant aspects of social well-being is the accessibility to societal necessities such as public service, healthcare, provision and not to omit, social interaction. Today we in the western world live in a society that is based on the assumption that the car enables this access. By assuming that MaaS can substitute all the mobility needs, without other radical changes in society, we will fail with the introduction of MaaS. Research is needed to assess how accessibility is affected when there is a shift in our consumption of mobility. This is also a targeted topic in the Urban Europe SRIA, theme Accessibility and Connectivity).

It is highly likely that the first MaaS offerings will be designed and implemented within urban environments since the latter are subject to a set of acute pressures and forces for change (e.g. urbanisation, congestion, local pollution) and represent
economies of scale whereby MaaS can be connected to existing PT systems and users. However, if MaaS is to fulfil social sustainability objectives (accessibility, social inclusion – see Farrington & Farrington 2005) then it is necessary to design and implement suburban and rural offerings and to connect MaaS ecosystems developed in different geographical and institutional contexts. In other words, MaaS ‘coverage’ must grow over time by connecting new geographical locations and transport modes, and must serve to integrate passengers and goods. In practice this necessitates multi-stakeholder approaches that can overcome the various barriers and obstacles to integration (Spickerman et al. 2014). To this end it is fruitful to examine the types of organisational and multi-stakeholder processes that can support wider processes of diffusion and adoption across time and space, preferably via studies that utilise comparative case studies within and across national boundaries in a longitudinal fashion.

**Dynamic aspects**

For MaaS business models to be ecologically sustainable, it is important that they are technologically dynamic such that they facilitate the uptake of new environmental technologies over time. In particular, it is important that MaaS serve to integrate new technologies from two fields: ICT and green propulsion technologies. ICT technologies are especially critical to the safety and efficiency of the road transport system in that they can be applied to “gather information, report accidents, control information panels and signs (speed signalling, highway dosage), and manage traffic flows”, and to autonomous vehicles enhanced with data processing, information transmission, and mobile communications capacities (Geels 2007). Green propulsion technologies and related infrastructures (e.g. hybrid and electric drives, fuel cell vehicles, electrified roads) are equally important to the future sustainability of road transport (Geels 2012), and MaaS ecosystems must thus be capable of integrating new technologies as they become available.

Some scholars have described business models as mediating devices that harness the economic value inherent in a given technology and deliver it to customers in terms of a product or service (e.g. Chesbrough & Rosenbloom 2002). Moreover, business model innovation can spur the adoption of new technology (Bohnsack et al. 2014; Kley et al. 2011), and several scholars have noted that new business models based on car sharing may unlock the potential of electric vehicle technology and assist in its
adoption (e.g. Budde et al. 2012; Costain et al. 2012; Weiller et al. 2015). As regards MaaS, however, it may be important that the business model and its associated ecosystem function as an innovation network that avoids the tendency towards techno-institutional lock-in that typifies sociotechnical systems (Unruh 2002). Whilst several scholars have characterised business models in terms of market devices with network effects that structure activities between different actors in an innovation network (Boons & Ludeke-Freund 2013; Chesbrough & Schwartz 2007; Doganova & Eyquem-Renault 2009; Mason & Spring 2011; Santos et al. 2009; Schatzki 2006, 2005; Stieglitz & Foss 2009; Zott et al. 2011), the role of MaaS business models in wider processes of systemic technological change (i.e. transitions within road transport) is not yet known.

**Resource efficiency**

Although high volume sales are inherent to the dominant business model within the automotive industry, there is potential to radically improve the resource efficiency of this sector by shifting towards servitised business models that facilitate a higher utilisation of road vehicles (MacArthur Foundation 2012). Instead of selling cars, automakers could sell mobility as a ‘function’ or ‘result’ (by selling travelled kilometres, for instance) (Williams 2007). This type of business model, though radical, also creates incentives to recirculate materials akin to the principles of a circular economy (Tukker 2015). In other words, MaaS has the potential to radically improve the resource efficiency of the road transport system, but this will likely require significant commitments and organisational changes within the automotive industry. Examining ways in which to engage the latter such that automakers align their visions and strategies to a world that is dominated by MaaS offerings and which is supported by the principles of a circular economy is another avenue for future research.

**Policy integration**

By combining different transport modes with environment friendly technologies and fuels, MaaS certainly has the potential to provide positive sustainability impacts. In order to realise this potential, however, it is important to perform other forms of integration from different institutional perspectives. One such area is public policy. The latter is critical to the development and adoption of green propulsion.
technologies, as they receive direct or indirect support via government subsidies for R&D programmes and from CO2 regulations. Yet many policies areas that influence the transport system are fragmented, such as environmental, economic and transport policies (EC 2011) and urban planning. The degree of fragmentation between these policy areas varies widely between geographical contexts, especially with regard to urban planning, which typically falls under the remit of local governments. Several scholars have argued for the integration of transport policy and urban planning and development practices. When outlining his vision for a ‘sustainable mobility paradigm’, for example, Banister (2008) argues that it is important to “strengthen the links between land use and transport”. That is, in order to encourage people to favour more sustainable transport modalities such as walking, cycling and public transport, it is important to create mixed-use urban environments with medium-range densities (over 40 people per hectare) as part of corridors with good access to public transport. Similarly, Sheller (2012) argues that new trends within sustainable urban planning (e.g. compact cities, clustering around public transport hubs, Transit Oriented Development) must be integrated with local factors linked to parking fees, congestion charging, city-centre accessibility, public transport subsidies, and bus/cycle lanes as part of a shift towards a more sustainable road transport system. Whilst the factors listed apply to road transport in a more generic way, they are also specific to MaaS. That is, urban planning and development activities are fundamental in that local governments can establish institutional arrangements (e.g. increased parking fees, reduced congestion charges, bus lane provision for MaaS vehicles, etc.) that can promote the implementation and adoption of sustainable forms of MaaS. Moreover, a high penetration of MaaS within cities has the potential to transform urban environments by, for instance, reducing congestion (and thus the need for investments in new road infrastructures) and by reducing the need for parking facilities.

**Institutional perspectives**

The development and implementation of sustainable forms of MaaS necessitates integration across different types of well-established organisations (i.e. institutionalised organisational environments). As noted in earlier sections, despite the fact that new entrants to the transport sector can initiate MaaS, it cannot be developed in a socio-political vacuum. The Uber case is instructive in this sense given the backlash from, for instance, local taxi operators. That is, conflicts can arise when new
MaaS initiatives serve to compete with existing transport offerings that are in turn connected to well-established organisational milieux. The need for public-private sector collaborations represents one potentially major obstacle to the realisation of sustainable forms of MaaS, and these problems are confounded by the need for cross-border collaborations given the diversities apparent in different institutional settings (e.g. variations in the provision of government subsidies for public transport). Finding ways to overcome such problems is a further avenue for future research.

The complexity of the transport system implies that a sustainable transition to MaaS must overcome further barriers and obstacles to change, some of which are so deeply entrenched that they have been described using the idiom ‘techno-institutional lock-in’ (Unruh 2000; 2002; Whitmarsh 2012). The field of transition management is useful for examining how such a transition to a MaaS-based transport system may be governed. Transition management has utilised concepts and frameworks from sociotechnical systems, the multi-level perspective and innovation system studies to characterise and examine systemic shifts within, for instance, large technical systems such as energy supply (Geels & Raven 2006), transportation (Elzen & Wieczorek 2005) and the utility sectors (Geels 2006; van der Brugge et al. 2005). Within this field, the concept of a transition is defined as:

“...a gradual, continuous process of change where the structural character of a society (or a complex subsystem of society) transforms. Transitions are not uniform, and nor is the transition process deterministic: there are large differences in the scale of change and the period over which it occurs. Transitions involve a range of possible development paths, whose direction, scale and speed government policy can influence, but never entirely control” (Rotmans et al. 2001).

A central concept in the field of transition management is that of a sociotechnical regime, which refers to the institutionalised (i.e. stable and inertial) character of sociotechnical systems (Rip & Kemp 1998). One such system is automobility (that is, the system that encompasses private ownership of the automobile), which is embedded in a multi-layered institutional context that contains various regulations, norms and cultural understandings and which also relies upon different types of physical infrastructure (Thynell 2013; Geels 2012; Urry 2004). The stability of a regime makes it resistant to change, and it has thus become the focal point in transitions studies and particularly within the multi-level perspective (MLP) (Geels 2011; Geels 2004). By examining drivers and barriers of change, this field is useful in that it can elucidate the various governance mechanisms (e.g. public policies,
standards, incentives) that actors can utilise to bring about a transition to sustainable forms of MaaS. It may also be used to outline transition ‘pathways’ (Geels & Schot 2007), which are cumulative sequences that describe the timing and nature of a transition. Here it is useful to consider MaaS as one potential pathway that may compete with others which have an institutional character. The dominant pathway that seeks to shift road transport onto a more sustainable path is that of ‘technological substitution’, where several actors (and particularly the automotive industry) aim to substitute (or at least supplement) the internal combustion engine with alternative fuels and technologies, but seeks to retain dominant business logics (e.g. high volume vehicle sales). If and when MaaS begins to threaten this logic, incumbents may naturally compete by offering environment-friendly vehicles at lower cost or higher performance. Here an in-depth understanding of transition pathways can serve to provide a further means of overcoming institutional barriers and obstacles to change.

**Roadmap for MaaS**

Whereas several initiatives and projects are now working to define roadmaps for MaaS, and there is a need for consolidation of those findings. Many of the actors in MaaS research and development are also in some way affiliated with MaaS alliance, which states its ambition to promote this.

In the research collaboration efforts with the Finnish MaaS cluster (VTT, University of Tampere), we developed a tentative common roadmap-view of how the MaaS landscape can evolve to enable a European MaaS landscape where roaming is possible between different MaaS enabled cities or areas. This description is to be seen as one approach and shall not be seen as complete.
Viktoria Swedish ICT

Viktoria Swedish ICT is a non-profit research institute dedicated to enable sustainable mobility by use of information and communication technology (ICT). The overall aim is to contribute to a worldwide development that takes care of the great challenges for the automotive and transport sector: oil dependency, accidents, and impact on climate and environment.
Annexes

Annex 1. List of MaaS related services available in Sweden

Ride sharing

- Bilplats
- Roadmate
- SpaceTime
- Skjutsgruppen.nu
- Samåkning
- Mobilsamakning
- Ropsten (Facebook group)
- GoMore

Car sharing

Non-profit

- Sambil
- Bilcoop

For-profit

- Car2Go
- Bilpoolen
- City Car club (Statoil Bilpool)
- Move About
- Uber
- Flexi Drive

Bike sharing

- Lundahoj
- Styr & Ställ
- Citybikes

Parking sharing

- Park Circa
- ApParkingSpot

Help with tasks

- Task Runner
- Hinner Du
- Butlr
Deliveries

- Urb-it
- MyWay
- Baghitch
References


