MaaS (Mobility as a Service) Market Futures Explored

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MaaS (Mobility as a Service) Market Futures Explored

Full Paper

Professor Marcus Enoch and Professor Stephen Potter

Abstract

The Mobility as a Service (MaaS) concept is powerful because it seeks to rapidly adjust supply and demand for transport so that an (ideally optimal) equilibrium point is attained. Whilst the technological barriers to implementing MaaS are steadily being overcome, less is known about how the MaaS eco-system might evolve.

This paper unpicks the MaaS concept in light of broader societal trends to suggest how it could evolve and offers insights to practitioners and policy makers. The paper draws on literature and discussions with stakeholders to better understand how MaaS has emerged. It constructs four future MaaS market scenarios and identifies implications.

The paper finds current expectations of how the MaaS concept may evolve to be unimaginative and limited in their understanding of how the transport system could change should MaaS be adopted on a wide scale. The major challenges for policy makers will likely relate to balancing the promised benefits offered with issues such as safety (including bio-safety in our post Covid-19 world), data security and privacy, equity and the threat of dominant unscrupulous suppliers distorting the marketplace. Together, these insights suggest that the MaaS reality may be messy and difficult to manage, and that future transport systems might look very different to now.

Keywords: Mobility as a Service (MaaS)  Product Service System (PSS)  Public Transit  Market Scenarios  Future Transport Systems  Transport Foresight
1 Introduction

Mobility as a Service (MaaS) systems seek to match the mobility requirements of customers for each trip that they make to a range of potential transport service options. This idea is powerful because it directly connects travellers with a range of transport providers in a dynamic marketplace, whereby the supply and demand for transport can be rapidly adjusted. The technology for MaaS is developing rapidly, but what is less well understood is how MaaS operators and the operators of specific MaaS functions might work together both in the wider transport system, and the consequences for practitioners and policy makers. The aim of this paper, therefore, is to unpick the Mobility as a Service concept in the light of broader societal trends to suggest how it may evolve in the future, providing insights to practitioners and policy makers.

The findings are based on a review of academic and grey literature, supplemented with many informal conversations over the years with colleagues and representatives from government agencies, transport operators, and other interested parties into what has become a ‘discussion paper’. Early results were also presented to the 2020 Annual Meeting of the Transportation Research Board (though not subsequently published) and feedback from that event is also incorporated into this paper.

The research topic that this concept discussion paper addresses concerns the seemingly narrowly focused understanding of what the MaaS concept is, and how the sector might develop in the future. In particular, it contains relevant lessons for the transport policy responses needed in a post Covid-19 world, and a context where strategies require a doubling of public transport use by 2030 in order to limit global warming to 1.5 degrees Celsius (ITWF/C40 Cities Leadership Group, 2021).

2 Defining Mobility as a Service

The increasing role of services in developed and emerging economies is a key feature of 21st century society. In a variety of sectors, consumers have shifted from gaining utility by owning products to using a service. The service may involve access to products, but the user does not own these. Such a service may simply be the leasing of a product to which a consumer has personal access (as in a personal car lease or mobile phone service package), but some involve a stronger sharing economy model, with transport examples including Car Clubs and City Bike/e-Scooter schemes. The distinction here is that, whereas car leasing provides the same access to a vehicle as ownership, Car Clubs and City Bike schemes provide on-demand access for a specific journey. A further stage in service development is the delivery not of access to individual transport products or services, but where the function of mobility is provided (Cook et al, 2006). This function might be to travel between A and B and the service provider draws upon a portfolio of transport services to deliver a
customised that trip for the user. Such a transport service concept has come to be termed as Mobility as a Service (MaaS).

MaaS is one example of a particular type of a Product Service System (PSS), and there is a considerable research literature about the definition, nature and consumer responses to PSS covering a range of situations where the use of an owned product is replaced by access through a service (Mont, 2002).

The different types of PSS, as noted in the above examples, has led to the development of a three level PSS classification (Hockerts, 1999; Cook et al, 2006):  
1. Product-orientated, where service is added to owned products;  
2. Use-orientated, when customers access products owned by suppliers, such as in a car club or city bike scheme;  
3. Result-orientated, when consumers acquire results, such as when mobility is supplied to customers.

Using this classification, MaaS is conceptually a level 3 result-oriented PSS, and this is how it tends to be defined (although transport researchers appear to have little awareness of PSS literature and its analytical approach). The UK Transport Systems Catapult (TSC, 2016) defines MaaS as “a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer” (ibid). MaaS envisages users buying mobility services as packages based on their needs instead of buying the means of transport (Karmargianni et al, 2016). That said, one issue has been a lack of clarity as to what exactly MaaS involves, with it being seen as a “complex, diverse and novel concept [that is] difficult to describe through a single definition” (Alyavina et al, 2022).

As a level 3 form of PSS, MaaS is generally perceived as being a one-stop online ICT interface comprising:
  - an intermodal journey planner (providing combinations of different transport modes: car-sharing, car rental, metro, rail, bus, bike-sharing, taxi, etc.) that operates in real-time;  
  - a single payment portal, whereby users can pay-as-they-go or else buy a ‘service bundle’ in advance; and  
  - a booking system incorporating the entire end-to-end journey stages.

As well as charging the user for providing a journey, MaaS software algorithms would also allocate income to the various transport service providers. Such ‘back office’ systems already exist, having been developed for online services involving multiple orders for customers on a platform with multiple providers – Amazon and airbnb being prime examples. For transport, there are some examples in less complex situation. One is that, in booking train journeys in the UK, a traveller can add a bus pass at each end of the trip; the booking software both adds a charge to the user for this additional service and forwards the charge to the bus operator concerned.
The business model for MaaS is of central concern but was initially somewhat overlooked in technically oriented approaches to its development, though this has changed more recently – e.g. see Vij and Dühr (2022), Van der Heuvel et al (2020) and Esztergár-Kiss et al (2020). Fundamentally however, MaaS could generate revenues to providers (TSC, 2016):

1. When a traveller buys a service bundle of transport journeys through the MaaS provider, the MaaS provider would take a fee before passing on those revenues to the transport operators who delivered the service.
2. MaaS providers can generate income through the data feeds that their Digital Service Platform generates, which transport operators and/or other software service providers could use to market and enhance their service offerings.
3. The platform could also host advertisements or attract commercial sponsors.

This is the sort of model used by digital service providers such as Amazon or the variety of holiday accommodation platforms. The second income stream could be significant were the data also marketed for other purposes, such as consumer profiling. This is an important commercial aspect of many free internet services and but raises personal privacy issues, particularly were MaaS to develop commercially. This would link to targeted advertisements or the whole MaaS service could have a commercial sponsor (as, for example, with the Santander Bikes scheme).

3 The emergence of Mobility as a Service

MaaS has emerged from two main sources. The first is from the transport sector where there has been a long-standing desire of policy makers to deliver ‘total journey solutions’ (Potter and Skinner, 2000), by integrating public transport routes, e.g. Tabassum et al (2017), timetables e.g. Ibarra-Rojas et al (2015), information e.g. Tavares et al (2015), and ticketing e.g. Puhe (2014). Related to this, there was impetus from the development of paratransit systems. These were mainly isolated transport services (i.e. level 2 PSS), but there are important insights from small-scale Dial-a-Ride (DaR) and Demand Responsive Transport (DRT) service trials in Scandinavia, Germany, the Netherlands, North America and the UK, e.g. Ambrosino et al (2016). Related to this, have been other level 2 PSS systems, such as car and bicycle sharing solutions. Over time these have begun to be blended within this picture, e.g. Shaheen et al (2012).

A second source for the MaaS concept has come from the IT industry; ‘Mobility’ is only one of dozens of ‘as-a-Service’ concepts (e.g. Software, Ontology, Routing, Monitoring) now being marketed (Sharma, 2016), and this revolution in data processing capability is having major impacts on the transport sector.

This joint heritage produces two main forms of MaaS-type schemes:
• Relatively local/regional-level, multi-modal and often local authority or public agency ‘transport or society-led’ solutions, such as Ubigo, SHIFT, EMMA, Mobility Mixx, HannoverMobil, Moovel, Chariot or Qixxit, (Karmargianni et al 2016; Ambrosino et al, 2016).
• Internationally focused, larger-scale, uni-modal and private-sector ‘commercially-led’ solutions, such as Lyft, Uber (and formerly Bridj). These are level 2 PSS (i.e. isolated transport services) and not the level 3 MaaS concept, but the learning and market development achieved could lead to them providing a Level 3 MaaS offering.

As noted by Watanabe et al (2015) the second involve the more significant actors and commercial MaaS offerings could be a lucrative development using IT firm’s existing core skills and platforms. So MaaS could emerge as something that, for example, Google Maps might provide as an additional service to its existing trip planning function. Adding MaaS to such a platform could generate additional income for an already successful business model.

3 The changing mobility system

Traditionally, mobility systems have comprised fixed assets (infrastructure – i.e. rights of way, power and control equipment, storage and maintenance depots, plus passenger stations and stops) and mobile units (vehicles) which are combined together with a set of rules for their operation to enable the movement of goods and people (Vuchic, 2007). This system design means that:
• Users have little direct influence on the type/level of public transport service they receive, unless they access a lift, or pay significantly more for a taxi or minicab.
• Operators are legally required to provide the services for which they are registered, whether or not anybody actually uses them at particular times. Such regulations exist whether the operator is state owned or private.
• Services are initially introduced based on limited amounts of historic customer needs/preference data, which is aggregated and averaged across the day/week/year and the route network using ticketing data where available.

With MaaS, the first key change is that transport users and providers now instantaneously communicate their needs via Digital Service Platforms (DSPs) which, for a charge, makes the most appropriate journey match (Djavidian and Chow, 2017). The second key change is the emergence of a whole new suite of shared services (e.g. lift sharing, bike sharing, micro-transit, car club schemes) (Shaheen, 2016). These changes raise the possibility that:
• Users can now tell operators of a transport service exactly the attributes they want of it: time of arrival, origin and destination points, degree of flexibility, type/level of comfort required, and price they are prepared to pay;
• Providers, which now number many more and offer many more types of service than previously, can choose to respond, or not;
• Users, providers and regulators can readily monitor service availability and hence adjust their travel behaviour, market strategy, or policy decisions accordingly.

In principle, this should result in customer-led services, tailored to the actual conditions in the market at any given time to the benefit of all, not least because suppliers can ‘dip in and out’ of the sector as they like (just like a someone might offer a spare bedroom through airbnb for a while and then withdraw it). This ‘paradigm shift’ from the traditional operator-led public transport environment described earlier is illustrated in Figure 1. Effectively, new IT-led services, and MaaS in particular, actively manage both supply and demand in near-real-time and in parallel – something which has not previously been possible (Hensher, 2017).

**Fig. 1** Transition pathways: Provider-led to user-led paradigm (bottom left to top right)

Such a goal is one with which the IT industry is familiar and opens up a strong commercial perspective; consequently a significant amount of work is underway in the IT sector (Shaheen, 2016), albeit much of it likely to be confidential. Specific
areas of operational focus include improvements to Digital Service Platforms, (Ruutu et al, 2017); the optimization of vehicle dispatch locations (Dimitriou et al, 2016); surge pricing and labour supply (Zha et al, 2017), and research on exploring demand dynamics (Kourti et al, 2017). Payment and ticketing systems are another topic; for instance, the use of electronic fare coupons for public transport as a means of developing a revenue stream that is suitable for MaaS (Chow, 2014). Privacy and security of MaaS systems is another component that has been studied (Belleti and Bayen (2017), whilst the legal and institutional issues around MaaS have been explored by, for example, Flores and Rayle (2017), who present a case study of the regulatory approach around Uber and Lyft in San Francisco. Relatively little has been written concerning the implications of MaaS for the vehicle to infrastructure interface, though there is more about the technological workings of vehicular ad hoc networks (VANETs) which enable vehicles to communicate with each other (V2V), as well as with roadside infrastructure units (V2I) (Benslimane et al, 2011). One exception is where MaaS features in an article on slot booking systems (Lamotte et al, 2017).

Few references were found using the terms ‘Freight’ or ‘Logistics-as-a-Service’, and these were focused on the technology of the Digital Service Platforms involved (Nowicka, 2014; Niharika and Ritu, 2015). Instead, terms such as ‘Smart Logistics’, ‘Smart City Logistics’, ‘Smart Connected Logistics’ are used, and there is just one reference (Grazia Speranza, 2016) that provides some ideas as to how these concepts could evolve in the future.

Finally, there is research into potential MaaS markets. Thus, Zha et al (2016) conducts an economic analysis of ride-sourcing markets and Harding et al (2016) examines the impact of Uber-type solutions on the taxi market. Smith et al (2018) draws on 19 interviews with MaaS actors in West Sweden to generate three scenarios – market-driven, public-controlled and public-private – to consider how MaaS could develop and affect conventional public transit in terms of the scope, usage, access, business model, competence structure and brand value. It finds that developing a regulatory framework to secure public benefits, whilst at the same time not stifling innovation, will be crucial if MaaS is to be mainstreamed. Esztergár-Kiss et al (2020) finds three cluster groups, namely 1) Route planners, which involves a few modes of transport but provides an extensive service; 2) Third parties, which has primarily private MaaS operators; and 3) Public systems, which usually includes public MaaS operators. Such studies are comparatively rare and focused on quite specific contexts, hence the broader scope of this paper.

4 Future scenarios for Mobility as a Service

In framing how the market for MaaS may evolve in the future, this paper presents the results of a Scenario Planning exercise. Scenarios are ‘imagined future worlds’ which
do not represent a future prediction but present a range of plausible futures to allow policies to be ‘tested’. This study undertook the following steps:
1) Identify drivers and define the axes;
2) Develop the scenarios;
3) Consider the implications.

Driver Analysis involves identifying key uncertainties in society and systematically assessing their implications. The method adopted was influenced by FHSC (2014) with the identified external drivers (i.e. technological, political, institutional, social and economic) influencing context-specific drivers relating to the type of user engagement with future mobility services. This identified the potential impacts to individuals, operations and society more generally. These aspects are now explored in turn.

4.1 External drivers

Technology is perhaps the most important driver concerned. In understanding the development of new products and services, Coombs (1996) concludes that Schumpeterian processes (i.e. technology-push) are more likely to be important at the birth of an industrial sector but are progressively moderated by Schmookler (i.e. demand-pull) processes with time. Specifically, digitalization, incorporating the Internet of Everything (IoE), sensors, mobile devices, consumer electronics, provides “the most significant technological trend faced globally” (Leviäkangas, 2016), especially when combined with internationally integrated telecommunication infrastructure and advanced programming algorithm methodologies. Not only transport, but the reasons people travel (employment, leisure, shopping) will be affected in ways that are very difficult to predict. For MaaS, crowdsensing is one especially interesting developing technology (Heiskala et al, 2016). In addition, the shift towards increasingly autonomous vehicles (Alessandrini et al, 2015) represents a major change in how transport will be delivered in future. There is also the forecast growth of so-called ‘little vehicles’ i.e. mobility scooters, scooters, e-bikes, velocomobiles, motorized skateboards, hoverboards, and other small, battery-powered low-speed vehicles, which could become significant short distance and feeder modes of travel.

Political drivers include the long-term trend in many countries for reductions in public spending for services such as public transport subsidies (Stiglitz, 2010). There have also been political moves to deregulate certain policy sectors (such as planning for example), and the ideal of promoting ‘choice’ as a means of improving service. But there are also growing concerns about climate change, energy security, congestion and poor air quality that have pushed governments towards ‘encouraging’ people to use cars less, by increasing fuel taxes or banning vehicles from city centres.
Institutional drivers are also promoting change within the intermediate transport mode supplier sector. One aspect is that the previously distinct leasing and rental sectors are becoming increasingly blurred; nearly 55% of all new cars in the UK are leased (SMMT, 2017). Additionally, multi-national transport corporations are investing in the new intermediate modes. For instance, in recent years rental car provider Avis Budget bought out car sharing operator Zipcar to expand its market reach, and car manufacturer BMW launched DriveNow, a point to point carsharing service, in partnership with car rental firm Sixt. Europcar acquired the eCar club and has integrating it into its commercial profile.

Social drivers include the rising proportion of elderly people no longer able to drive, and younger people increasingly excluded from car use through more demanding driving tests and rising insurance premiums, as well as attitudinal factors (Delbosc and Currie, 2013). There is also a new culture of ‘collaborative consumption’, whereby material possessions are lent and borrowed (Cheng, 2016). Attitudes to issues such as privacy are also continuing to develop (Cruikshanks and Waterson, 2012).

4.2 Contextual drivers

In exploring how context may feed into future mobility trends, one study from the New Zealand Ministry of Transport’s PT2045 project devised four scenarios, of which two ‘Mobility Marketplace’ and ‘Competitive Commons’ involve MaaS elements (NZMOT, 2018). Mobility Marketplace assumes a low population density setting and that, whilst sharing will become common, the private car remains important. The Competitive Commons speculates that car ownership will be far less important in a high-density environment with far more sharing options being available. Interestingly both scenarios sit in the ‘partially automated’ as opposed to the ‘fully automated’ future space, suggesting that MaaS may be superseded should driverless vehicles become universally adopted.

However, the development of new forms of autonomous transit systems could considerably widen the scope of a MaaS approach (Potter et al, 2020). This can constitute another future scenario (Enoch, 2015), with a convergence of modes towards a universal driverless taxi service. In bringing these findings together, Snellen and de Hollander (2017) suggest that demand for mobility services will become increasingly informed. There will be an increased choice of transport options, travel time will be more productive, the geography of destinations will change, and the mobility system will become more complex. Finally, the advent of self-driving vehicles will produce further significant changes. Taking a similarly broad view, Table 1 suggests how the design of the ‘public’ transport’ service may begin to evolve in the future as a result of the changing circumstances mentioned, and how the operational, regulatory and planning mindset may need to adjust.
### Table 1 Transitioning from a traditional to a future public transport model

<table>
<thead>
<tr>
<th>Nature of vehicles</th>
<th>Traditional transit model</th>
<th>Comments on transition</th>
<th>Future transit model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Holistic, specialist, single use, manually driven.</td>
<td>Efficiency gains from modular designs are likely to make vehicles useful for more of the time. Similarly, using infrastructure for as much of the time as possible for many different purposes would enhance the efficiency of infrastructure.</td>
<td>Modular, generalist, multi-functional, automated.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nature of infrastructure</th>
<th>High cost, specialist infrastructure (for transport, even single mode)</th>
<th>Low cost, general purpose infrastructure (transport plus other functions)</th>
</tr>
</thead>
</table>

| Schedule-type | Fixed timetables | Passengers prefer to use services that arrive when and where they are needed, with limited walking. Up to now, such services have not been economically viable due to the need for drivers, inflexible attitudes to vehicle design and infrastructure management, insufficiently personalised and up-to-the-minute trip data, and outdated institutional arrangements. However, driverless technology, new vehicle and infrastructural developments, big data, mobile internet, and cheap new mobile ticketing technologies are now shifting possibilities, and hence result in more flexible regulatory regimes at some point. | Demand responsive services |

<table>
<thead>
<tr>
<th>Route-type</th>
<th>Fixed routes</th>
<th>Flexible routes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Stop configuration</th>
<th>Checkpoint to checkpoint (few to few)</th>
<th>Door to door (many to many)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Information (delivery basis)</th>
<th>Static information</th>
<th>Dynamic information</th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th>Information (content type)</th>
<th>Standardised information</th>
<th>Personalised information</th>
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<table>
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<tr>
<th>Pricing basis</th>
<th>Fixed pricing</th>
<th>Variable pricing</th>
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<tr>
<th>Pricing structure</th>
<th>Fixed pricing</th>
<th>Real time pricing</th>
</tr>
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<table>
<thead>
<tr>
<th>Pricing elements</th>
<th>One price per journey leg</th>
<th>One price per whole journey</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Nature of service delivered</th>
<th>Fragmented service delivery at person journey level</th>
<th>Integrated service delivery at person journey level</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Operational philosophy</th>
<th>Supply-led</th>
<th>Demand-led</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Operational mechanism</th>
<th>Planned in advance</th>
<th>Market based – supply reacts to demand</th>
</tr>
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</table>

#### 4.3 Impacts
In devising the scenarios, it is helpful to first review a series of MaaS studies on how people interact with MaaS, how the systems work operationally, and at how MaaS systems may impact on society.

At the personal level, in one study of a small-scale MaaS operation, on Ubigo in Gothenburg, the key service attributes identified by users included the ‘transportation smorgasbord’ concept, simplicity, improved access and flexibility, convenience, and economy (Karlsson et al. 2016).

There is more research on the growth and development of Uber, e.g. (Watanabe et al, 2016; Harding et al, 2016), albeit this is a level 2 PSS and not level 3 MaaS. There is work on the importance of personalization settings in shared vehicle environments (Kuemmerling et al, 2013) and the UK Transport Systems Catapult (2016) advocates more research on the impact of MaaS on travel behaviour, reporting that the effects were “unknown”. The American Public Transport Association (2016) reports:
1) people using shared transport modes tend to own less cars even than those who used public transport alone;
2) shared modes complement public transport use: being used most often when public transport is not an attractive alternative;
3) shared modes will continue to grow in significance;
4) there is a need for institutional changes if the sector is to mature in a desirable way.

Similarly, Rio (2016) examines the influence of Uber on ethnic groups in Baltimore, and Cheyne and Imran (2016) explore the effects of MaaS on energy use in small towns in New Zealand. Meanwhile Butler et al (2021) note that MaaS led to reduced vehicle kilometres travelled, parking, and private vehicle ownership, and improved social equity, they also note that MaaS struggles to appeal to older generations, public transport users, and private vehicle users in particular. Respondents to a Delphi study expect MaaS to operate first in urban areas and then to rural areas over the next decade; and early adopters to be younger people, current public transport users, and flexible travellers (Jittrapirom et al, 2020).

At the operational level, the Ubigo system was found to blur modes (in terms of services, infrastructure, information, and payment), and this blurring between public and private operators proved challenging due to the regulations and institutional barriers (Karlsson et al, 2016) which is also emphasized in other studies (Potter et al, 2020). Next, Sulskyte (2021) notes that limited cooperation between stakeholders is a barrier, whilst more broadly Butler et al (2021) report supply side barriers relating to lack of public private cooperation, business and political support, service coverage, and vision.

Taking a market perspective, success for MaaS Digital Service Platforms depends on "gaining a critical mass of end users, developers, and service providers and achieving
self-sustaining growth and scalability” (Ruutu et al, 2017). Arriving at the right business model is vital in terms of pricing structure and building up a critical mass of service developers and providers on the one hand and service end users on the other. Clearly the number of competitors is also important, as is the degree of interoperability between the platforms – a high level of API standardization is desirable. Thus, Bahamonde-Burke et al (2021) highlights the likelihood of a MaaS monopoly occurring, particularly with the widespread adoption of autonomous vehicles. Ambitiously, Wong et al (2020) propose a government-contracted model for MaaS, where the package includes a form of road pricing that is sensitive to time of day, geography and modal efficiency to help improve the broader transport system and deliver more sustainable outcomes. Aligned with this view, is that the financial and sustainable success of MaaS is by no means guaranteed, and crucially depends on how operators and users engage with the concept (Alyavina et al, 2022).

At the societal level, simulations of autonomous shared taxis in Lisbon, indicate a 45% per kilometre reduction on current public transport fare levels and significant land savings (if properly ‘locked in’) (Martinez and Viegas, 2017). This simulation study notes that shared fleets will compete with (and even replace) taxi and bus services, which may be desirable, so public governance will need to adapt. Enabling the sharing of autonomous vehicles is also seen as an important means of limiting potentially negative externalities (e.g. vehicle numbers, congestion, sprawl) following rapid AV adoption (Gruel and Stanford, 2016). Less specifically, societal impacts could potentially be significant and will need to be carefully managed (TSC, 2016). One other perspective is that MaaS provides a real opportunity to match customer needs more closely to service supply and support conventional public transit services, but this is likely only if institutional frameworks can be modified (Hensher, 2017) – an issue also identified by Sulskyte (2021). Guyader et al (2021) also notes the importance of institutions in the MaaS ecosystem. Finally, Butler et al (2019) concludes that consideration of local characteristics is critical for successful implementation, there being there is no ‘one-size fit all’.

5 Scenario development

From the above analysis, three MaaS dimensions were explored:

- Market consolidation ranges from fragmented to consolidated, from perfect competition, to monopolistic competition, oligopoly and finally monopoly.
- Service consolidation again ranges from fragmented to consolidated, from single components of MaaS such as payment services, booking services, brokerage platform, or specific types of journey, to operators that provide every element.
- Market scale could range from the neighbourhood level to the global.

From this framework, four scenarios emerge:
5.1 Scenario 1: Highly consolidated market, and highly consolidated services

This scenario represents the model most expected by many local and regional governments, particularly in Europe, whereby each regional public transport authority would establish its own MaaS platform monopoly. Qualifying transport service providers, potentially a mix of commercial, public-sector and/or community organizations, would then join each platform and could apply for subsidy to provide non-commercial but socially necessary journeys. Current examples of such schemes are being piloted in Helsinki, Finland and the West Midlands in the UK.

**Benefits:** Strong local government control would ensure the market operated in the public interest and be properly coordinated – fare levels and minimum service quality standards being ensured through regulatory controls. Services would also enjoy a very local flavour which might be appreciated by users.

**Issues:** Attracting providers to operate under such conditions may prove challenging due to high entry barriers. This could result in limited levels of competition in less attractive market environments. Diseconomies of scale and scope may also stifle innovation, reducing potential efficiency gains and limiting consumer opportunities.

**Implications:** This scenario could see the adoption of official almost standardized regionally applied MaaS concessions being let every 3-5 years and then operated by a mix of international, national, and regional commercially-minded suppliers, along with a small number of local public and/or voluntary operators – not unlike the present bus market in many European countries. Such concessions would first be introduced in progressive cities with good transport options, and these experiments would be intensely studied by more risk averse local authorities. If the outcome of these schemes is positive, there would be a steady growth of other areas inviting transport and related companies to operate MaaS systems in their localities. However, the uptake of MaaS in some areas may not happen at all should these initial schemes not be particularly successful. In some cases, this model may also lead to some operators who failed to win the franchising competitions to develop systems outside of the agreed regulatory environment.

5.2 Scenario 2: Highly consolidated market, and highly fragmented services

This global oligopolistic future sees multi-national commercial organizations each entering the MaaS marketplace to capture the business in their particular field of operation. Transport operators such as Stagecoach and Deutsche Bahn would seek to dominate public transport trips; car rental companies like Avis and Hertz would manage most of the car sharing operations; Uber and Lyft would lead the provision of taxi-like lift sharing options; and big car park operators (such as NCP in the UK) would provide the car parking spaces. Crucially almost everyone would connect with
each other through a fully open and accessible DSP (perhaps provided by a global IT provider such as Google) and pay through credit card payment systems.

**Benefits:** Significant efficiency savings due to scale economies and focus on market-leading expertise in each specific sector. The market would be stable and consistent across the world, so attractive to highly mobile consumers.

**Issues:** High barriers to entry would limit innovation and could prevent improvements from being adopted.

**Implications:** Some elements of the service chain would be less competitive than others – e.g. payment systems and DSP platforms – which together with the fragmentation of the MaaS service in this scenario could mean there is no single MaaS regulation agency, with regulatory duties spread across various financial, competition, communications and transport regulatory agencies. It would also be important that regulatory duties be properly resourced if consumers were not to be disadvantaged and abused. In addition, some MaaS components would evolve more quickly than others, but once developed there would be a rapid worldwide uptake.

### 5.3 Scenario 3: Highly fragmented market, and highly consolidated services

A range of service providers (large and small) that individually offer different components form partnerships and/or merge with others, such that (say) Amazon-Arriva-HSBC would compete with (say) MTR-Mastercard-Yahoo-Toyota, and Uber-Diners Club-SNCF to deliver seamless end-to-end journey solutions to transport users in a monopolistic environment. Users making trips that are recognized as being ‘socially desirable’ are directly subsidized with there being no supply-side subsidies. All but the most rural areas would have at least two or three providers, and users would choose the package that suits them best. Perhaps the closest parallel to how such a market might look is the telecommunications market across the European Union. Here, on average there are 3-4 mobile network operators per member state which compete by offering a range of subscription and pay-as-you-go ‘packages’ comprising telephone, text, data, and other ancillary services to consumers who then choose the most offer that best meets their needs (EC, 2018).

**Benefits:** Low to medium barriers to entry would produce a diverse and contestable market which is steadily improved as new innovations are adopted, whilst consumers are still able to shop around for deals most appropriate for them.

**Issues:** For consumers, it could be extremely challenging to understand and secure the deal that is best for their needs, whilst switching between providers can often be an arduous process. More generally, prices are likely to be set above marginal cost due to allocative inefficiencies.
Implications: Regulators may need to intervene to ensure clarity of customer information, that customers are not unfairly ‘locked in’ to deals that may not suit them, and that prices are not exploitative. It is also possible that nations will adopt a high level of regulatory alignment to encourage more service providers.

5.4 Scenario 4: Highly fragmented market, and highly fragmented services

This model envisages a highly fragmented, almost neighbourhood-level marketplace that is highly competitive comprising many thousands of transport service providers (ranging from individual ‘little vehicle’ owners renting out a scooter for a limited time period or car owners offering lifts for one-off trips, to local bus companies and multinational multi-modal operators) promoting their service offerings to a multitude of MaaS DSPs. Users pay via their own favoured banking service thanks to the adoption of standardized data and payment API structures. Fare levels change in real-time (within bounds), according to the service attributes required by the user, the level of demand for the service, and the quality of service delivered. Such an environment is already beginning to evolve in London, whereby cashless contact credit/bank cards are set to replace the dedicated Oyster transport payment card and a whole range of new mobility products are now being trialled – e.g. ViaVan, Uber Pool, Smart Ride and Chariot (bus-taxi hybrid schemes); Urbo, Mobike, Ofo (shared bike schemes); Drivy, DriveNow, Zipcar (car club schemes); GoCarShare, BlaBlaCar, liftshare.com (lift sharing schemes).

Benefits: Barriers to entry are low, so users have a large degree of choice, whilst poor quality and/or overpriced services are quickly forced out of the market.

Issues: Low profit margins reduce the incentive for companies to innovate, so the growth of the sector may be limited. ‘Too much’ choice, especially in an unstable market where providers and services are rapidly changing, can also make it difficult for consumers to access the solution that would best meet their needs.

Implications: Such a mobility eco-system could be chaotic without a firm regulatory framework in place from the start. This would need to be based on core operational and market principles and be flexible enough to adapt to new service configurations and technologies and need to engender high levels of trust from all parties (governance, provider and consumer). Interestingly, under this scenario there may be scope for competing regulatory frameworks, which may in turn lead to best practice institutional regimes being created.

6 Implications for decision makers

MaaS is still at an early stage in its development, as highlighted by the recent failures of two high-profile examples, both for financial reasons (Djavadian and Chow, 2017).
Kutsuplus in Helsinki failed because massive scale was needed to make the economics work, but the significant public cost of doing that was too much for the local authority to accept. Similarly, Bridj in the USA ceased operating when it could not find a major investment partner to scale up its operations. More research is plainly needed on business models for the early stages of such innovations. A stepped scale business model is needed that is viable at all stages of innovation diffusion. The MK Connect example (Potter et al 2022) represents a stepped scale business model that works towards MaaS, in that this app-based service provides a platform for both DRT and route bus services. Once it becomes more established, the intention is to add in other transport services and move towards more of a MaaS product.

Key policy challenges will focus around the accessibility, availability, (cost) efficiency and acceptability of transport, whilst policy makers will need to switch from a reactive mode to be more proactive (Snellen and de Hallander, 2017). The American Public Transport Association (2016) proposes Public Transport Agencies become Mobility Agencies, and form partnerships and collaborations with (a wider range) of service providers. It adds that data and payment APIs need to be standardized, and that administrative subsidy and investment programs be more targeted and transparent. Similarly, Miles and Potter (2014) suggests the role of local authorities will need to be less directive. Rather than being project managers, funders, and service providers, their role would become more facilitative and supportive of the ‘new’ sector in being network builders and leveraging access to finance and other resources as a partner agency. In this respect there could be lessons to be learnt from the travel plan sector, whereby the most successful examples benefit from partnership working between non-traditional transport actors, transport operators, and local authorities (Enoch, 2012). Similar conclusions were drawn by Calvert et al (2019). In their study of the business models applied in on-demand shared-ride road transport niches; they noted that a key innovation was the emergence of new models of partnership working.

Results from a study exploring the uncertainties in implementing automated vehicle taxis focused on the need for an adaptive or flexible approach to policy making, to limit the potential for errors (Walker et al, 2017). One approach could be to regulate the day to day aspects of each transport operator (driver licensing, subsidy allocation, etc.) almost as now, but to also classify operators by their level of specialism (e.g. occasional, regular, specialist), whereby the more specialist the operator, the tighter the regulations but the greater the operational benefits and opportunities (Enoch and Potter, 2016). ‘New’ modes would no longer be forced into operating pre-conceived service patterns and should allow for occasional providers to ‘safely’ join the transport market when an opportunity arises.

Taken together, these insights suggest a great deal of uncertainty still pervades the future of MaaS, which might indicate a course of ‘wait-and-see’ to policy makers. Yet there is a strong feeling that a significant re-alignment process is already
underway, and this requires serious consideration and positive action by policy makers if they are to effectively influence how this new transport paradigm ultimately develops. The best approach might seem to be as open and flexible as possible to the opportunities that arise, whilst being careful not to become locked into particular paths too early. Rather than seeking a comprehensive MaaS service, it looks like stepped approaches that leave options open may well be the best way forward. These might integrate on a platform only a couple transport services, but can then form the foundation for further development. On balance, it is likely that the transport policy landscape will look quite different in the years to come as MaaS-type services becomes more mainstreamed, a situation potentially messier and more difficult to manage than many transport practitioners and policy makers currently imagine.

7 Conclusions and future research

Overall, this paper finds that MaaS does not yet have a major presence in either the research arena nor in society more generally, though this is changing quickly. MaaS potentially offers a paradigm shift from transport being fundamentally provider-led (i.e. effectively fixed capacity being provided to serve an assumed unchanging demand), to being a fully user-led system whereby the level and type of transport supply are continually adjusted in response to the specific desires of individual travellers. Accordingly, major challenges exist for policy makers, who will need to balance the promised benefits offered with issues such as safety, data security and privacy, equity and the threat of dominant monopolistic suppliers distorting the marketplace.

Whatever the eventual structure of the market, it seems unlikely that MaaS could provide major transport benefits to either users or policymakers until it is applied at a large scale. A major challenge is in developing a business model that can work at a small scale and yet be effectively scaled up as demand increases. There is also an issue of the transport services that MaaS is drawing upon to offer a mobility service. MaaS offers value where a portfolio of transport services need to be integrated to provide mobility to a user. Yet most existing public transport trips do not require this, and so MaaS will add little value to existing public transport users. Where MaaS would come into its own is if it combined with serious improvements to transport services through the development of a range of new transit modes. DRT particularly comes to mind in this respect. In and of itself, a smart 21st century interface to deliver a 20th century set of transport services will do nothing but disappoint and fail to gain any users who have the option to use a car.

The Covid-19 situation, although happening after this research was conducted, is of relevance. In the wake of the pandemic, much has been said about making space for bicycles, developing public bike renting schemes and, now, making rented eScooters legal in the UK. A window of opportunity has opened where new transit modes, plus traditional ones such as cycling, could emerge from new patterns of travel. A
transformative change could be facilitated by integrating these through a MaaS platform, together with other more flexible modes (e.g. Uber share, Via Van etc.) and quickly delivered innovative high-quality public transport services (e.g. tram quality buses and autonomous vehicles). MaaS needs not just to integrate existing transport services, but to facilitate the development of new ones.

However, this still leaves the question of who should take the lead in the transition to such a future. Major transport consultancies see MaaS as the next big area for them. Local and regional transport authorities see MaaS as the solution to public transit failing to attract car users necessary for transport and sustainability ambitious policy aims. But for both, the expertise, experience and the commercial returns seem likely to be outside of their fields. Instead, it is the IT services sector that is the most likely to develop viable MaaS-style offerings because MaaS is a logical extension of their existing operations, core expertise and business model. Consequently, transport practitioners and policy makers need to build alliances with this sector, not make futile attempts to duplicate and outcompete it. There is no chance of doing that.

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References


