Australasian Transport Research Forum 2021 Proceedings
8-10 December, Brisbane, Australia
Publication website: http://www.atrf.info

# The commercial viability of Mobility-as-a-Service (MaaS): What's in it for existing transport operators?

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## Abstract

Mobility-as-a-Service (MaaS) platforms offer consumers access to multiple transport modes and services, owned and operated by different mobility service providers, through an integrated digital platform for planning, booking and payment. Different transport operators can choose to offer their services on the platform, and the platform provider has to broker individual deals with different transport operators on a case-by-case basis. Ultimately, the success of any MaaS platform will depend on the platform provider's ability to persuade as many individual transport operators as possible to join their platform, to increase value to potential customers. This study examines the commercial value proposition of MaaS from the perspective of individual transport operators, based on a comprehensive review of the existing academic and grey literature on MaaS, and based additionally on qualitative interviews with over 60 national and international actors across the entire MaaS ecosystem. We find that transport operators might benefit from MaaS through possible changes in their cost structures and revenue streams. MaaS could help strengthen potentially complementary relationships between services; allow operators to expand their customer base and reach newer markets; and increase asset utilisation through better matching between supply and demand. However, MaaS also poses a potential risk to existing service providers, as integration with possibly substitutive services could undermine profitability and cost recovery. In many cases, similar benefits can be realised through information and communication technologies that do not require integration with other services. Consequently, if left to the market, integration between operators is likely to be piecemeal and ad-hoc. In the absence of government support, MaaS is unlikely to deliver on the vision of a fully integrated transport system.

## 1.Introduction

Mobility-as-a-Service (MaaS) systems offer consumers access to multiple transport modes and services, owned and operated by different mobility service providers, through an integrated digital platform for planning, booking and payment (Hensher et al., 2020a; Kamargianni et al., 2016; Sochor et al., 2016; Heikkilä, 2014; Hietanen, 2014). MaaS has attracted great interest in recent years from both industry and government actors working in the transport sector across the world. The private sector sees new business opportunities; the public sector is interested in ensuring outcomes that maximize societal benefit. For example, several studies have argued that MaaS has the ability to reduce private car dependence and facilitate greater public transport use, through improvements to the overall travel experience (see, for example, Sochor et al., 2016).

MaaS was first trialled in Gothenburg, Sweden in 2013. Since then, similar services have been introduced in, among others, Finland, England, Germany, Austria, France, Italy, Switzerland, Japan, Singapore and Australia (for comprehensive reviews of existing MaaS systems worldwide, the reader is referred to, among others, ITS Australia, 2018; Jittrapirom et al., 2017; and Kamargianni et al., 2016). Despite the interest from the private and public sector in the potential opportunities arising from MaaS, most MaaS pilots to date have been implemented in small-scale settings with low levels of integration, and there are only a handful of commercial examples that offer fully integrated access to the entire transport network in their local markets. The success of similar integrated platforms in other industries, such as media streaming and e-commerce, has at least in part been attributed to their ability to present a compelling value proposition to individual service providers (Hietanen, 2020). Unless MaaS can identify an equally compelling value proposition for individual transport operators, it is unlikely to deliver on the vision of a fully integrated transport system.

The objective of this study is to examine the commercial value proposition of MaaS from the perspective of individual transport operators. Multiple previous studies have examined potential consumer demand for MaaS, and consumer willingness-to-pay for access to different MaaS service offerings (e.g. Fioreze et al., 2019; Ho et al., 2018). To a lesser extent, previous studies have also examined the role of regulation and governance in aiding and abetting the development of MaaS (e.g. Smith et al., 2018; Surakka et al., 2018), as well as MaaS' reciprocal ability to support government and societal objectives (e.g. Becker et al., 2020; Wong et al., 2020). However, "far less work has to date been undertaken on the supply-side, particularly around potential [MaaS] business models" (Hensher et al., 2020a) and the commercial viability of MaaS.

To the best of our knowledge, Polydoropoulou et al. (2020) and Berg et al. (2020) are the only studies that have examined prototypical MaaS business models and their value propositions for different actors. Polydoropoulou et al. (2020) used qualitative data from workshops and interviews with transport operators, government bodies and other actors across the broader MaaS ecosystem to identify barriers and opportunities for different prototypical MaaS business models. Berg et al. (2020) developed analytic economic models of consumer and firm behaviour, and used different numerical examples to simulate how profit and welfare are likely to vary across different business models and market contexts. Differently from these concurrent studies, our analysis is based on a qualitative review of existing and new quantitative evidence from a wide variety of sources that can shed further light on the subject.

For MaaS to offer value to consumers, different transport operators offering services in the same local market, often in direct competition with each other, will need to agree to share a common MaaS platform. For transport operators to be interested in joining a common MaaS platform and integrating with other operators, the MaaS platform will need to offer clear commercial benefits in terms of increased revenue and/or reduced costs. Based on a comprehensive review of the existing academic and grey literature on MaaS, and based additionally on qualitative interviews with over 60 actors from Australia and other countries across the entire MaaS ecosystem[1], we identified the following six broad opportunities and challenges that MaaS could offer existing operators:

1. MaaS could strengthen potentially complementary relationships between services; but could also threaten existing services that are in direct competition;
2. MaaS could increase service use over time through subscription plans that offer customers bundled access to multiple transport services;

[1] To protect the confidentiality of participating individuals and organisations, we have withheld all names.

3. MaaS could improve revenue management through dynamic and differentiated pricing that is targeted at specific services and customers with a higher degree of precision than is currently possible;
4. MaaS could increase visibility and exposure for existing transport services, particularly those operating at smaller scales;
5. MaaS could increase utilisation rates of underused public and private transport assets (e.g. community transport, courtesy transport, buses, carshare) by better matching supply and demand; and
6. MaaS could reduce operator costs by outsourcing critical functions, such as ticketing, and leveraging economies of scale by integrating these functions across multiple transport modes and services.

In the sections that follow, we examine each of these potential benefits and their consequent risks in greater detail, based on our review of existing evidence, supplemented, wherever possible, by our additional engagement with different actors across the MaaS ecosystem. We conclude with a synthesis of our major findings, and what they imply for the successful provision of MaaS.

The economics of transport integration will vary as a function of the local context. We selected Greater Sydney and the larger state of New South Wales (NSW), Australia as our case studies for the metropolitan and regional contexts, respectively. Over following sections, we have tried as much as possible to include evidence from these contexts. Wherever necessary and/or useful, we have also included selected evidence from other regions, nationally and internationally.

# 2. Integration with complementary services

MaaS platforms aim to offer consumers integrated access to transport services owned and operated by different service providers. We reviewed the academic literature to identify broad patterns of complementarity and substitution between different pairs of transport services, and to understand the extent to which individual services might stand to benefit from integration with other complementary services through a MaaS platform. In general, we expect that highly complementary services will be eager to integrate with each other, while highly substitutive services will be wary of integrating with a potential competitor.

Our review examined the nature of the relationship between the following six broad transport services: public transport, taxis, rideshare, carshare, bikeshare and e-scooters. We summarise the relationships in Figure 1. Over following paragraphs, we describe the key findings that emerged from our review.

First, public transport is predominantly complementary to other services. Most services would benefit from closer integration with local public transport systems, emphasising its role as the backbone of any potential MaaS offering. However, public transport itself may not always benefit from these relationships. In local contexts where the relationship is substitutive, private services with smaller mode shares will stand to gain from integration at the expense of public transport.

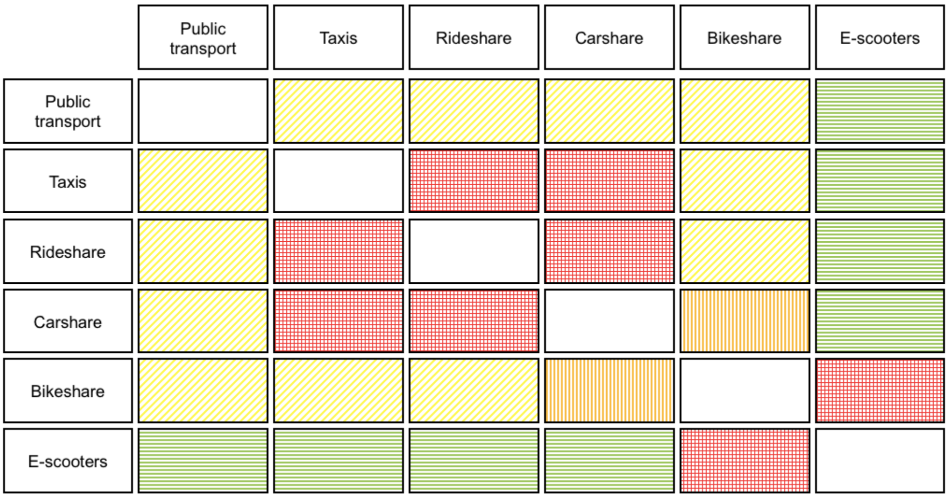


**Figure 1:** Patterns of complementarity and substitution between different transport services (red / grid lines – strongly substitutable, orange / vertical lines – weakly substitutable, yellow / diagonal lines – weakly complementary, green / horizontal lines – strongly complementary)

Second, rideshare, taxis and carshare services have a highly competitive relationship. The relationship between rideshare and taxis is strongly substitutive. The relationship with carshare is weakly substitutive, but our engagement with operators indicates a strong sense of rivalry between these services. In general, each of these services view the others as competition, and are usually reluctant to integrate with each other.

Third, shared micromobility services that provide access to e-scooters are predominantly complementary to other services, whereas bikeshare services are weakly complementary and, in some cases, weakly substitutive to other services. However, both bikeshare and e-scooter services could serve as potential first and last-mile solutions for long-distance trips made using public transport and/or other motorized private transport services. Additionally, neither service is viewed as a threat by other transport service providers,

In general, relationships between different pairs of services are highly contextual and localised, and far more complex than indicated by Figure 1. Even the most complementary relationships can, under certain contexts, be substitutive, and vice versa. Take, for example, the relationship between public transport and rideshare. In general, studies report a partially complementary relationship between the two services, but this relationship varies significantly by context. The 2019 Uber FerryConnect trials in Sydney, Australia illustrate the complicated nature of this relationship. The trials allow UberPool users to request rides to or from the Manly Wharf in the city, between 6-9 am or 4-7 pm weekdays, from within a catchment area with a maximum distance of roughly 7 km from the wharf, for a capped fare of $3.50. By linking up with ferry services at the wharf, rideshare serves as a first and last mile solution targeted at commuters. Consumer surveys of service users conducted by Uber, shared in confidence by the company with the authors for the purposes of this research, reveal that the overall demand for ferry services has increased, but also a significant fraction of users have substituted bus trips with the rideshare service as their preferred first and last mile solution. In this case, rideshare appears to have served as a complement to local ferry services, but as a substitute for other local public transport services.

# 3. Subscription plans

MaaS allows interested transport operators the ability to offer pre-paid access to one or more transport services at potentially discounted rates in the form of subscription plans with recurring charges (different from MaaS schemes that offer pay-as-you-go access). The use of subscription plans is still somewhat new to the transportation industry. While public transport operators have historically used season passes and other variations to offer pre-paid access to their services at discounted rates, they differ from our definition of a subscription plan in that there is no recurring charge. Subscription-based pricing has proven very successful in other industries. Telecom operators have used tiered subscription charges to offer customers access to cell phone and internet data at differing volumes; media streaming companies, such as Netflix and Spotify, have used flat monthly subscription fees to offer customers unlimited access to their content; and software companies, such as Adobe and Microsoft, have used tiered subscription charges to offer customers short-term access to their software. In many cases, subscription plans lie at the heart of the as-a-service model.

The popularity of subscription plans from the perspective of suppliers can be ascribed to multiple factors (Tzuo and Weisert, 2018). They help retain customers, and help increase their service use over time by encouraging them to move to higher-paying tiers. They allow the supplier to improve the quality of their service through customisation and personalisation. They help simplify business processes because demand is more predictable. And finally, they bring stability to the company through more steady cash flows, which in turn can enable more long-term strategy and planning.

Subscription plans for transport access have been trialled by some MaaS operators. For example, *Whim* offers customers in Helsinki, Finland the option to choose from four subscription plans, that offer varying levels of discounted bundled access to public transport, taxi, carshare and bikeshare services[2]. The city of Augsburg, Germany has launched a similar MaaS platform called *Mobil-Flat*, where customers can get unlimited access to public transport and bundled access to car shares and rental bikes for a fixed monthly sum[3]. However, market uptake of MaaS subscription plans has been lower than expected (Ho et al., 2021; Linton and Bray, 2019). Academic studies that have employed stated preference experiments to assess consumer preferences have reported similar findings as well in that the majority of consumers prefer pay-as-you-go schemes over subscription plans that offer pre-paid access (e.g. Caiati et al., 2020; Guidon et al., 2020; Vij et al., 2020a).

There are three major challenges to the commercial viability of MaaS subscription plans. First, in industries such as telecom, media and software, where subscription plans have proven to be popular, the marginal costs of serving extra customers is nearly zero. For example, it costs streaming businesses like Netflix and Spotify and telecom operators like Telstra and Vodafone very little to serve extra users on their platforms, because the marginal cost of media streaming or making a phone call is very small. This is true to a limited extent of some public transport services, particularly during off-peak periods, as shown in Table 1 for Greater Sydney. These are capital intensive services with high fixed costs but low marginal costs, such that the costs of serving additional customers on the network (up to a

[2] https://whimapp.com/plans/
[3] https://www.intelligenttransport.com/transport-news/91851/germanys-first-mobility-flat-rate-starts-in-augsburg/

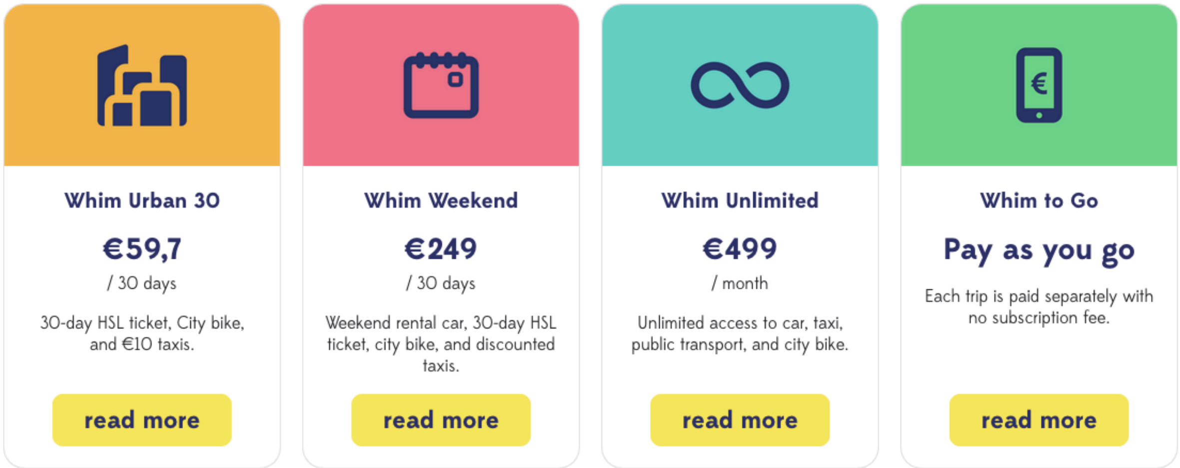


**Figure 2:** MaaS subscription plans offered by Whim in Helsinki, Finland

limit) are negligible. However, highly individualised labour-intensive services, such as taxis and rideshare, have high marginal costs. In such cases, offering unlimited access for flat monthly fees is unfeasible. The only viable alternative is to offer tiered fee structures based on use, as in the case of Whim.

Second, most individuals are not accustomed to thinking about the marginal costs of their transport use (ITS Australia, 2018). While Whim's monthly subscription plans are comparable in price to the actual costs of car ownership (RACQ, 2019), after accounting for operation, maintenance, insurance, depreciation, etc., they are higher than what most individuals think they spend on transport (see Figure 3). For subscription-based pricing to work for MaaS, it will need necessarily to be accompanied by appropriate public awareness and education campaigns that make consumers aware of the hidden costs of private car ownership, and help position MaaS as a viable and sustainable alternative.

And third, profit margins in transport are much lower than other sectors of the economy. The subscription model is relatively recent to most economic sectors. Media platforms such as iTunes and Amazon tried initially to charge customers for their marginal use (e.g. pay-per-view services), but that business model was disrupted by the arrival of streaming services like Netflix and Spotify that charged flat prices. Even in the telecom industry, early mobile phone plans charged customers for their marginal use of texting and calling functions. The rise of the subscription model in these industries has reduced profit margins, not increased them (Laudon and Traver, 2016; Berman et al., 2011). In the transport industry, where most public services have cost recovery factors of roughly 20-40 per cent (IPART 2016b), and most private operators are struggling to show profitability, the subscription model may therefore not be very viable.

**Table 1:** Marginal costs per trip for different public transport services in Sydney, Australia (in AU$)

| **Service** | **Peak period** | **Off-peak period** |
|---|---|---|
| Trains | $5.28 | $1.90 |
| Buses | $2.15 | $0.47 |
| Ferry | $6.87 | $0.55 |
| Light rail | $3.54 | $0.35 |

*Data source: IPART (2016)*

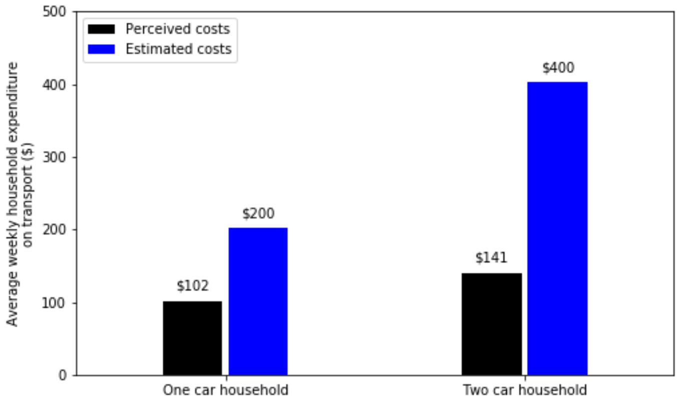


**Figure 3:** Average expenditure in AU$ on transport for households with different levels of car ownership; perceived costs are calculated using data collected from 3,985 nationwide respondents by ITS Australia (2018); estimated costs are from RACQ (2019) for a medium-sized car

# 4. Dynamic and differentiated pricing

MaaS could enable transport operators to dynamically price services in real-time, to increase revenues and profits. For example, Uber already uses surge pricing to manage supply and demand on its network. Some toll roads in the United States employ dynamic pricing to maintain free-flow conditions (Konishi and Mun, 2010). MaaS could enable public transport operators to achieve similar levels of targeted dynamic discounting, with a view to maximising asset utilisation, managing network demand and increasing system ridership. This practice of yield management has been applied in other industries as well, such as airlines, hotels, theatres and fashion labels (Gallego and Ryan, 1994). For example, American Airlines reported a 5 percent increase in revenue from more effective yield management (Smith et al. 1992). Surge pricing has been credited with a 3 per cent increase in profits for ridesharing services such as Uber (Cachon et al., 2017).

**Table 2:** Own price elasticity of demand for different public transport services in Sydney

| Distance band | Train (adult weekday, post-peak only) | Bus (adult weekday) | Ferry (adult weekday) |
|---|---|---|---|
| < 3 km | -0.069 | -0.183 | - |
| 3 – 8 km | -0.370 | -0.413 | -1.247 |
| 8 – 20 km | -0.644 | -0.289 | -1.510 |
| > 20 km | -0.597 | -0.339 | - |

Data source: CEPA and HG (2018)

By offering service providers a more complete and more detailed picture of transport use across different modes and services at differing levels of spatial, temporal and human aggregation, MaaS could allow service providers to tailor their prices to a greater degree of resolution than is currently possible. While shared mobility service providers already use these principles to varying degrees, the implications of price discrimination strategies are particularly profound for public transport services. The use of new technologies within public transport in the past, such as smartcard payment, real-time information, etc., has largely focused on improving the customer experience. MaaS could additionally allow public transport operators to better monetise the value in their services.

Dynamic pricing has often been criticised, particularly in the case of ridesharing platforms such as Uber out of concern for the car driver/owner. However, analysis by Cachon et al. (2017) finds that in cases where the rideshare service is undersupplied, the car driver/owner stands to benefit as well from dynamic pricing, provided their contract with the platform is based on a commission, and not a fixed wage rate. In some cases, it can even be shown that dynamic pricing strategies are socially optimal. Chen and Gallego (2019) report that in most cases, revenue-maximising dynamic prices increase consumer surplus, and for systems with scarce capacity, revenue-maximising dynamic pricing strategies are optimal for welfare. For example, in the case of underutilised rail services, discounted rates can benefit both old and new customers without compromising the quality of the service. For a thorough discussion of these and related issues concerning the economics of ridesharing services, the reader is referred to Button (2020).

Discounted pricing could offer significant benefits for underutilised public transport services. But for these benefits to be realised, they need to be targeted at services that are price-elastic. Otherwise, the increase in ridership at discounted prices will not be sufficiently high to make up for the reduction in revenue from existing customers. Table 2 reports average own price elasticities of demand for different public transport services across different trip distance bands in Sydney, Australia, as estimated by CEPA and HG (2018). For both trains and buses, demand is inelastic, and a network-wide discount would reduce revenues and increase losses. We report off-peak elasticities for trains, peak demand is even less elastic. Only in the case of ferry services for weekday travel is demand found to be elastic. Therefore, only in the case of ferries does a network-wide discount have the potential to increase revenue. For trains and buses, discounts need to be targeted at specific services that are price-elastic. In general, demand for different public transport services has found to be price inelastic at the network level across most empirical contexts. For example, based on a meta-analysis of 81 different estimates, Holmgren (2007) find that the short-run (static) own-price elasticity of demand for public transport is -0.75 in Europe, and -0.59 in North America and Australia. Therefore, similar caution is warranted across other contexts when applying network-wide discounts.

Conversely, MaaS could also be used by operators to enforce surge pricing. In general, surge pricing needs to be targeted at services with price inelastic demand in order to increase revenue. The benefits of surge pricing to shared mobility service providers are likely to be limited, as these services could already employ these principles through their own IT systems, and as mentioned previously, some already do. The ability of public transport services to charge above their listed fares is also expected to be limited, as it creates the concern that transport disadvantaged and vulnerable groups might be priced out. However, MaaS could technologically allow public transport services to identify customers in terms of their degree of disadvantage and vulnerability at a more detailed level than is currently possible, and to charge them appropriately differentiated prices. In effect, this would create a more nuanced concessions scheme, with more fare tiers and more customer sub-groups. Again, in order for net revenues to increase, demand for sub-populations that are subject to fare increases would need to be price-inelastic.

Relatedly, MaaS could also be used by local governments to enforce road user charging schemes as part of congestion management strategies. Sydney has one of the biggest networks of toll roads in the world. A handful of international cities, such as Singapore, London and Stockholm, have employed cordon-based charging schemes with similar intentions. In theory, the integration of road user charging schemes within MaaS would offer car drivers an alternative way of accessing information relating to the scheme, and paying appropriate charges under the scheme. However, in the long run, MaaS could also be used to incentivise car drivers in other less coercive ways to forego driving, for example, through access to discounted public transport fares (e.g. Gärling and Schuitema, 2007).

Finally, MaaS could enable operators the ability to offer user-focused pricing schemes that are personalised based on existing use of different transport services. For example, *Tripi* - a 6-month in-field MaaS trial in Sydney conducted in 2020, “adopted an incremental approach to the design of monthly bundles for the participants to subscribe to” (Ho et al., 2021). In the first month, all participants were only offered a pay-as-you-go option with no monthly charges, that offered integrated access to the following services: public transport, taxis, rideshare, car rental and carshare services. Based on the demand for different services, the research team conducted segmentation analysis to design monthly bundles tailored to suit different segments (see Ho et al., 2021 for more details).

The reader should note however that many of these potential benefits can be achieved through improved data collection and analysis, facilitated by other advances in ICTs, without necessarily requiring integration with other services through a MaaS platform.

# 5. Visibility and exposure

MaaS could help grow ridership on existing underused services with spare capacity through potential increase in the level of awareness and ease of access. Public transport and shared mobility services are frequently fragmented. This is particularly true in regional and remote areas, where public transport use is low, and public awareness and familiarity with these services tend to be low as well (Outwater et al., 2010). For example, our interviews with community and patient transport operators in Dubbo found that these operators spend considerable time and resources playing the role of journey planner for their respective patrons. Staff members are frequently on the phone with both customers and other transport operators, trying to match available services with willing customers. MaaS could be of considerable benefit to these operators, offering a single dashboard through which they could coordinate supply and demand. Uber is already using these principles in the US through its offering Uber Health[4], "to provide flexible ride-scheduling options for patients, caregivers, and staff. Healthcare professionals can schedule rides for patients and caregivers going to and from the care they need, all from a single dashboard."

Even in urban areas, the recent and relatively rapid proliferation of privately-operated shared mobility services has created a pool of small transport operators that could benefit from increased visibility and exposure – something which could be offered by a Maas platform. Existing private operators spend large proportions of their total costs on promoting customer awareness of their service offerings. For example, in 2018, Uber spent $3.2 billion or 28 per cent of its revenue on sales and marketing to increase customer acquisition (Griswold, 2019). Small operators cannot compete with established operators such as Uber. MaaS could help eliminate some of these power asymmetries by providing all operators the same platform from which to offer their services. In turn, this could help create a more competitive mobility market across urban areas, to the benefit of both small operators and customers.

However, similar levels of visibility and exposure could potentially be achieved through improvements to existing journey planners, without requiring integration with booking and payment functionality across different transport services.

# 6. Asset utilisation

In previous sections, we examined how MaaS could allow operators to price their services more effectively as a demand-side tactic to increase revenues and profits. Now, we discuss how MaaS could allow operators to manage their assets more effectively as a supply-side tactic to achieve the same objective. MaaS could help tailor underused services in terms of routes, timetables, catchment areas, etc. to better match them with passenger demand. Rideshare services have used similar information and communication technologies to develop efficient matching and pricing algorithms that have significantly improved capacity utilisation rates in the point-to-point market. For example, Cramer and Krueger (2016) compare capacity utilisation rates for taxis and ridesharing services across five major US cities. They find that "UberX drivers, on average, have a passenger in the car about half the time that they have their app turned on, and this average varies relatively little across cities… In contrast, taxi drivers have a passenger in the car an average of anywhere from 30 percent to 50 percent of the time they are working, depending on the city… On average, the capacity utilisation rate is 30 percent higher for UberX drivers than taxi drivers when measured by time, and 50 percent higher when measured by miles" (ibid., p. 177).

There are parts of the public transport network with low utilisation rates, such as buses, community transport, and courtesy transport[5], that could profit from these same technologies.

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[4] https://www.uberhealth.com/au/en/

[5] Services which are not generally available to the public, or which are incidental to another kind of business, such as a nursing home using a vehicle it owns to take residents to a doctor's appointment; a club using its vehicles to provide a courtesy service to its members; or a sea kayak tour company or surf school using its vehicle to provide transport to its clients from a pick-up point (e.g. their accommodation) to the beach.

For example, Hensher (2017) describes various approaches to increase patronage and utilisation rates, such as replacing low patronage late night buses with rideshare or combination services, and/or improving integration between rideshare and public transport. To an extent, ongoing on-demand transport (ODT)[6] trials in NSW are already evaluating the efficacy of this model. Multiple bus, community and courtesy transport operators are trialling the use of their existing underused assets for the provision of ODT services. For example, LiveBetter, a community transport provider in the Dubbo region, is currently operating four ODT services using its community transport vehicles that connect various town centres in the region to one another. Similarly, carshare service provider GoGet and public transport operator Keolis Downer have partnered under the name Keoride to operate ODT trials in the Northern Beaches and Macquarie Park regions of Greater Sydney. The trials are being run by Keolis Downer using underutilised cars from GoGet's carshare fleet that are now being used exclusively to ply the ODT services (i.e. GoGet members can no longer use these vehicles through their carshare membership).

The reader should note that increase in capacity utilisation rates can be achieved through efficient matching and pricing algorithms. Integration with other services could improve the performance of these algorithms. However, integration is not always necessary, as demonstrated by rideshare services and ODT trials.

# 7. Ticket outsourcing

MaaS could allow operators to outsource functions such as ticketing that can be done more effectively by a third-party mobility aggregator. Ticketing can comprise a significant proportion of total costs for transport operators, but ticketing systems are frequently subject to significant economies of scale. Consider, for example, Table 4 that compares the costs of public transport ticketing systems across different jurisdictions as a function of the scale of their operations. Compared to London, average ticketing expenses per trip are an order of magnitude higher in Australian jurisdictions. However, London also serves significantly more passenger trips than any of the Australian jurisdictions, and the difference in average ticketing expenses per trip "likely reflects substantial economies of scale" (CIE, 2015).

It is possible that ticketing aggregators could achieve greater economies of scale, by integrating ticketing across multiple modes and services, owned and operated by different actors across the public and private sector. However, for these savings to be realised, trip volumes will need to be sufficiently high, i.e. the mobility aggregator will need to attract a majority of existing trips across modes and services that they seek to integrate. Take-up of MaaS services currently in the market has been much lower than total patronage on local public transport networks. For example, a year after its full commercial launch in Helsinki, Finland, Whim has roughly 70,000 registered users (Ramboll, 2019). In comparison, the Helsinki Region Transport Authority's HSL public transport network serves roughly 0.98 million daily trips on its network (HSL, 2015). These figures indicate that it will take MaaS brokers considerable time to increase their customer base to the size needed to leverage

[6] IT-enabled shared public transportation services that serve passengers using dynamically generated routes and schedules, and may expect passengers to make their way to and from common pick-up or drop-off points. Vehicles can range from large SUVs to vans to shuttle buses. They are contracted by the public sector. These services have also been referred to in the literature as demand responsive transport (DRT) and flexible transport services (FTS).

economies of scale. In turn, cost savings from outsourcing ticketing and related functions are not likely to be realised in the short-term.

Furthermore, ticketing costs are already falling dramatically as public transport operators have shifted away from paper tickets through smartcards to open-loop systems using contactless cards or mobile apps. The most recent data for Transport for London shows that the cost of collecting fares had fallen from 14.3% of revenue in the 2005-2006 fiscal year to 9.2% in 2015-2016 with a goal of reaching 6%, as "the cost of processing a contactless transaction is around 80% lower than the cost of processing a transaction at an Oyster Ticket Stop" (Clark, 2019). The cost of "ticketing" for rideshare, bikeshare and other providers is difficult to ascertain. In general, the shift to contactless payments across different transport services, either through credit cards or mobile apps, will only further undermine the ability of third-party mobility aggregators to achieve substantial savings by integrating ticketing across different services.

**Table 3:** Operating costs in AU$ for public transport ticketing systems across jurisdictions

| Metropolitan area | Patronage – Trips across public transport system | Per trip ticketing operating cost |
|---|---:|---:|
| Sydney, Australia | 1.51m daily average in 2012-13 | $0.26 |
| Melbourne, Australia | 1.47m daily average in 2014 | $0.14 |
| South-East Queensland, Australia | 0.48m daily average in 2014-15 | $0.26 |
| London, UK | 10.9m daily average in 2014-15 | $0.04 |

Data source: CIE (2015)

# 8. Synthesis and conclusions

Mobility-as-a-Service (MaaS) platforms offer consumers access to multiple transport modes and services, owned and operated by different mobility service providers, through an integrated digital platform for planning, booking and payment (Kamargianni et al., 2016; Sochor et al., 2016; Heikkilä, 2014; Hietanen, 2014). Different transport operators can choose to offer their services on the platform, and the platform provider has to broker individual deals with different transport operators on a case-by-case basis. The platform provider may charge a commission or a flat fee for every transaction made through the platform, usually a nominal amount, to cover their costs of building and running the platform. In highly deregulated markets in Europe, our interviews revealed that mobility brokers have had to negotiate with hundreds of operators within a single national market. Ultimately, the success of any MaaS platform will depend on the platform provider's ability to persuade as many individual transport operators as possible to join their platform, to increase value to potential customers.

Our analysis finds that the benefits to transport operators from joining a third-party MaaS platform are still somewhat speculative, highly localised and frequently contextual. Large transport operators are reluctant to integrate with other services that could erode their own core offering. This sentiment is perhaps strongest within the taxi industry. They have already been adversely impacted by the rise of rideshare services, and are understandably wary about the promise of MaaS. However, we encountered similar resistance when speaking with carshare and rideshare operators as well. These operators would rather build MaaS platforms themselves that can act as walled gardens, where they can retain control over what products and services are offered through the platform. Small operators with smaller market shares are usually more open to joining a MaaS platform, as they view it as an opportunity to reach newer markets and expand their customer base. However, they frequently do not have the capital resources or the technological capability to feed their services into a digital real-time platform, and are reluctant to take on the risk of being the first-mover by investing in the requisite infrastructure.

Finally, both small and large operators only want to join a third-party platform if there are clear commercial benefits to their business. They are reluctant to part with their share of the revenue from sales through the platform, particularly when the benefits are not apparent. For example, as part of the MaaS Innovation Challenge in New South Wales, Australia, one of the participating firms had originally proposed to build a MaaS platform that would provide "operator-independent journey planning and ticketing in a single app across end-to-end journeys". The idea was predicated on a "clip the ticket" business model, where the MaaS platform provider would receive a commission out of the ticket price. However, transport operators proved unwilling to part with their share of the revenue, rendering the proposition unviable. Similarly, an ongoing MaaS trial in Sydney is offering participating consumers access to public transport, taxis, rideshare, car rental and carshare services at potentially discounted rates (Hensher, 2020b). However, participating transport operators have been assured that they will receive their regular fares, the MaaS platform provider will not charge a brokerage fee, and customer discounts will be paid out by the platform provider.

In summary, from the perspective of existing transport operators, evidence appears to indicate that demand growth and/or cost savings from joining a third-party MaaS platform, at least in the short-term, are not obvious. Our findings echo the analysis of Berg et al. (2020), who report that transport operators would lose profits from joining a third-party MaaS platform under a majority of cases, when compared to the status quo. We find that MaaS also poses a risk to existing transport operators, as integration with potentially substitutive services could undermine profitability and cost recovery. In many cases, similar benefits can be realised through information and communication technologies that do not require integration with other services. Consequently, third-party MaaS platform providers are struggling to recover the costs of developing and operating a MaaS platform, and the business model is unlikely to be commercially viable in the short-run without some form of government support and/or intervention. However, we leave it for future research to determine if and how government involvement is necessary and desirable.

# Acknowledgements

This research is funded by iMOVE CRC and supported by the Cooperative Research Centres program, an Australian Government initiative; and Transport for New South Wales (TfNSW). The authors would like to thank Virginie Vernin for providing essential feedback on different aspects of this study.

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