MOBILITY AS A SERVICE

Research summary, conclusions and action recommendations.

arising from iMOVE research

Prepared by Tulipwood Economics

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Abbreviations and terms

ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ANZSIC	Australian and New Zealand Standard Industrial Classification
API	Application Programming Interface
App	A service (or application) that operates on a digital platform
CBA	Cost Benefit Analysis
CCC	Car Community Club (or 'Triple C')
FTE	Full-time Equivalent (employment)
GHG	Greenhouse Gas
GOC	Government Owned Corporation
GRP	Gross Regional Product
GTFS	General Transit Feed Specification
GSP	Gross State Product
IA	Impact Assessment
IAG	Insurance Australia Group Ltd
iOS	Apple's mobile device operating system
IPART	Independent Pricing and Regulatory Tribunal
IT	Information Technology
ITLS	Institute of Transport and Logistics Studies (Uni Sydney)
ITS	Intelligent Transport Systems (Australia)
KPI	Key Performance Indicator
MaaF	Mobility as a Feature
MaaS	Mobility as a Service
NEC	Not elsewhere classified
NPV	Net present value
PAYG	Pay as You Go
PC	Productivity Commission
PT	Public Transport
R&D	Research and development

RMIT	Royal Melbourne Institute of Technology (University)
RTRH	Regional Town and Rural Hinterland (MaaS Blueprint)
SEQ	South-East Queensland
SKPI	Societal Key Performance Indicator
TfNSW	Transport for NSW (Government Department)
TMR	Transport and Main Roads (Qld Government Department)
UniSA	University of South Australia
UQ	University of Queensland
WTP	Willingness to Pay

Executive summary

The iMOVE Cooperative Research Centre (iMOVE) commissioned Tulipwood Advisory Pty Ltd (Tulipwood Economics) to prepare an overarching report summarising iMOVE's Mobility as a Service (MaaS) sponsored research projects and to provide recommendations for the further development of MaaS in Australia. The conclusions and recommendations made in the report, while informed by the iMOVE sponsored research, were developed by Tulipwood Economics.

What is Mobility as a Service?

Mobility as a Service (MaaS) is a concept that integrates public and private transport options — like trains, buses, and ride-sharing — into a single 'one stop shop' making it easier for customers to plan their travel without relying on a private vehicle. The concept is realised via a digital platform (e.g., an app on a smart phone) that provides access to multiple service providers across multiple transport modes in a fixed price bundle. The bundle can be purchased on a pay-as-you-go (PAYG) basis or as a time-limited subscription (e.g., monthly). The MaaS concept nudges the transport planning and policy focus from service provision (i.e., supply) more towards the individual customer (i.e., demand).

A MaaS digital platform provides journey information, and booking, ticketing and payment capabilities. In theory, MaaS platforms can operate at any spatial scale (i.e., urban or regional or global) and cover any combination of transport modes (including private car use) and even non-passenger transport related services (e.g., grocery and parcel delivery). In practice, MaaS has generally found its niche in large cities with significant and reliable public transport networks, which form the backbone of the bundled service offering. The MaaS platform is more than a stand-alone digital journey planner or real-time travel information service because these types of services do not offer an integrated ticketing and payment system that could alter mode selection, which is at the core of the MaaS value proposition.

Vij and Dühr (2022) provide a succinct definition.

> 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. (Vij et al 2022, p.12).

Bundling multiple transport services allows consumers to choose exactly what they need at a price they are willing to pay. This is in the same way that a digital streaming service (or cable tv in an earlier era) caters to multiple tastes and, hence, draws sufficient customers to be commercially viable. Bundled pricing alternatives, whether PAYG or subscription based, can then potentially shift the modal choice incentives faced by consumers and, hence, change travel behaviour.

In addition, transport service providers, via the MaaS platform, are better able to cater to individual customer preferences and meet market demand at, potentially, a lower overall cost. By utilising digital platform technology, MaaS has the potential to drive faster innovation in transport services, reduce transactions costs and achieve scale economies, and provide customers with a greater range and pricing of transport options that better align with their needs and preferences.

What is the MaaS value proposition?

The MaaS value proposition is potentially strong, especially in Australia's major cities where more than three-quarters of us live and work and study.[1] A well-designed MaaS offering can potentially provide consumers with advantages over purchasing mode-specific transport services separately, including greater convenience, more choice, improved and/or more equitable mobility access, and reduced annual travel costs. To the extent that an integrated MaaS service eliminates the need for a person or household to purchase and maintain their own private vehicle, the annual financial savings could be significant.

Increased MaaS adoption can potentially reduce private car ownership by giving consumers greater options for transport, thereby decreasing congestion, traffic incidents, and contributing to environmental goals via reduced greenhouse gas (GHG) pollution. From a public policy perspective, these three well known social costs of private car use are used to justify governments charging for public transport services at below full cost recovery (i.e., using tax revenue to partly fund those services).[2]

In summary, there are five key benefits of MaaS:

(i) Enhanced User Experience and Convenience: By integrating various transport options, such as public transport services, ride-hailing, car-sharing, and bike-sharing, MaaS platforms enable users to plan, book, and pay for their trips using a single app.

(ii) Reduced Traffic Congestion: MaaS has the potential to significantly reduce traffic congestion, traffic incidents and, relatedly, parking pressure in urban areas, by encouraging the use of shared and public transport options and decreasing the number of single-occupancy vehicles on road networks.

(iii) Improved Accessibility and Equity: MaaS platforms can improve transport accessibility and equity by offering a wide range of mobility options that cater to diverse user needs. By including services such as wheelchair-accessible vehicles, discounted fares for low-income users, and user-friendly interfaces, MaaS can help ensure that transport systems are more inclusive and accessible.

(iv) Environmental Benefits: MaaS can contribute to a reduction in GHG emissions and particulate pollution by incentivising a shift from private vehicle use to more environmentally sustainable modes of transport. By integrating options like electric bikes, scooters, and electric vehicle-sharing services, the MaaS platform can encourage users to adopt low-emission transport alternatives, especially via bundled pricing strategies that target environmental sustainability goals.

(v) Wider Economic Benefits: MaaS can potentially stimulate economic growth and job creation by fostering innovation within the transport sector and promoting a more efficient use of scarce resources. The development of new services, technologies, and infrastructure to

[1] Two-thirds of Australia's population live within the boundaries of the eight capital cities, and three-quarters of the population live in the capital cities and largest regional towns (ABS 2023). Accessed: https://www.abs.gov.au/statistics/people/population/regional-population/2021-22

[2] This would be welfare enhancing only if these social costs are reduced otherwise the PT subsidies would be inefficient.

support MaaS can create employment opportunities in research, engineering, data analytics, and customer service. As an ecosystem where technology plays an integral role, MaaS also offers the prospect of continual innovation, with new business models and ways to organise and operate the various transport modes.

Where is MaaS currently operating?

The MaaS concept emerged in Scandinavia in the mid-2010s. It was first trialled in Gothenburg, Sweden in 2013. One of the early commercial pioneers was MaaS Global, which launched the 'Whim' app in Helsinki in 2016. The app is considered the world's first MaaS platform and is based on a monthly subscription model. Finland has demonstrated some success with MaaS in rural and regional contexts in addition to dense urban areas. A law promoting MaaS was passed in Finland in 2018, which brought together previously separate transport modes under a single legislative framework. This facilitated the development and implementation of MaaS by encouraging data sharing and integration, and created an ecosystem for mobility services that could be used by both public and private MaaS operators via the "Transport Code", which also required transport operators to make single tickets available for resale via third parties. Several of Finland's MaaS offerings provided non-mobility services, including parcel and grocery delivery, and providing various social services.

A MaaS trial ran in Sydney, Australia in the summer of 2019-20. The project was led by IAG, Australia's largest general insurer, in partnership with the Institute of Transport and Logistics Studies (ITLS) at the University of Sydney, which provided research and project management support, and iMOVE. The MaaS app used by trial participants was developed by SkedGo, a private MaaS application developer, under guidance from IAG and ITLS. One hundred IAG employees in Sydney participated in the trial. From a technical, operational and consumer viewpoint, the trial was a success. Unfortunately however, the trial had to be terminated prematurely due to the onset of the COVID pandemic.

Another NSW-based project, the Regional Town and Rural Hinterland (RTRH) MaaS Blueprint, which ran from October 2021 to June 2023 in regional NSW and was run by ITLS in partnership with TfNSW and iMOVE. The project was not a conventional MaaS trial, rather it aimed to develop a blueprint to guide future trials in regional NSW.

In 2021 a MaaS trial called ODIN Pass was initiated in SEQ. This trial, which is ongoing at the time of writing, has been led by the University of Queensland and supported by iMOVE and Queensland's Department of Transport and Main Roads (TMR). The ODIN Pass trial, which serves UQ staff and students, began with a pre-trial survey to determine the most feasible service/price bundles to offer. The trial was subsequently extended to include Intelligent Transport Systems (ITS) Australia Conference participants (held in Brisbane in August 2022). The model is commercially based, with a separate company ODIN Pass Pty Ltd being formed to run the MaaS concept. The trial has demonstrated technical feasibility in terms of integrating several modal options for consumer bundles.

Overseas, full MaaS platforms with varying modal options are currently operating in several countries in Europe, although the distinction between a journey planner type app and a full MaaS service can be, in some cases, difficult to ascertain. There are many 'MaaS light' services, which provide a limited number of modal choices to consumers. An example of a full MaaS service is the Whim app, which is currently (March 2024) available in in Italy and Turkey.

Issues and challenges

Although the MaaS concept has been successful in terms of its technical feasibility in a number of large overseas cities, the future success of MaaS as a commercially viable and universal service, as opposed to a niche transport service, will depend on several factors. These can be categorised as technical, commercial, legal and regulatory. These four factors are interlinked — for example addressing privacy issues involves challenges across all four factors. One important determinant of success that cuts across all factors is the capacity for the private and public sectors to form strong partnerships based on clearly defined common goals, shared values, and agreed outcomes and most importantly, trust.

Technical factors

The technical feasibility (or 'proof of concept') of providing a MaaS platform has been demonstrated via a number of successful MaaS trials and the ongoing operation of MaaS services in a number of cities around the world. Digital platform services rely on a fast 'digital highway' and data centre (i.e., cloud computing) services to store and retrieve information in real time, both of which have improved steadily over the past decade as a result of very significant investments in undersea cables, fibre optic networks, satellites and data centres. Smart phones and tablets have also improved significantly in recent years with greater processing speed and storage capacity and higher resolution (and larger) screens. Providing an identical MaaS platform for the two most common mobile phone operating platforms (i.e., Apple's iOS and Android) has also been successfully achieved in most instances.

The key technical challenges relate to customer data ownership, access, sharing and integration, and these issues are linked to legal and regulatory factors (discussed further below). They include:

(i) Interoperability and Integration Challenges: MaaS platforms rely on the smooth functioning of different modes of transport services, payment systems, and information systems. The lack of standards or common platforms can make this integration difficult, leading to fragmented services for the customer. In a number of cases, legacy public transport IT systems have been challenging to integrate into newer MaaS platforms. More generally, there is significant logistical complexity involved to integrate several different operating, finance, and management systems into a single MaaS platform.

(ii) Data Security and Privacy Concerns: Data security and privacy are significant concerns in the MaaS ecosystem. Given the amount of personal data (e.g., travel patterns, payment information) that users must share to use MaaS platforms, ensuring that these databases are secure, and privacy is maintained is critical. Any breaches can result in loss of user trust, which can severely impact the adoption of MaaS.

(iii) Infrastructure and Connectivity Issues: Robust digital infrastructure and reliable connectivity are prerequisites for successful MaaS implementations. However, areas with weak digital infrastructure or unreliable internet connectivity can face challenges in implementing MaaS. This is particularly an issue in rural, remote, or underserved areas where the digital divide is more pronounced.

(iv) Increased Complexity: For some customers, such as the elderly or people with disability, the use of an app could be very problematic. Some customers may feel uncomfortable navigating a new way of doing things and/or not have access to the appropriate technology device, and this may limit the uptake and utilisation of MaaS platforms.

In our view, adopting a customer-centric approach can help overcome these technical challenges by clearly defining the goals of the MaaS offering.[3] By understanding and prioritising customer needs, MaaS providers can ensure that their services are convenient, reliable, and meet the users' mobility requirements, which can drive adoption rates.

Governments also have roles in regard to:

> Data security and privacy concerns which can be addressed by governments establishing robust security standards, including encryption and anonymisation of data, secure payment gateways, and adherence to data protection laws.[4]
> Infrastructure and connectivity issues which can require strategic investment in digital infrastructure, particularly in underserved areas. This could involve both public and private sector participation, such as ensuring sufficient digital coverage in regional, rural and remote Australia.
> Improving digital literacy for those more vulnerable customers such as the elderly and people with disability. For example, carer's could be supported to help their clients use a MaaS platform.

In addition, governments have a critical role to foster an innovation-friendly policy environment to encourage the development and deployment of advanced technologies to address these challenges. This could involve supporting research and development (R&D) through the tax system or via direct budgetary support, supporting trials and start-ups in the MaaS ecosystem, and implementing policies that facilitate technological innovation.

Commercial factors

A viable MaaS platform service requires customers finding incremental value in the service beyond the existing apps and ticketing services offered separately by public and private transport providers. As a general matter, a profitable business operating in a competitive market — assuming it does not, on net, generate what economists call negative externalities, (i.e. unpriced social harms) — usually demonstrates that a socially beneficial service is being provided.[5] That said, a loss-making MaaS may still be socially beneficial if it generates net positive externalities, (i.e. unpriced social benefits such as improvements in environmental sustainability), and those net benefits exceed the operating losses incurred. In this regard, it may make sense for governments in certain circumstances, via their publicly owned PT services, to invest in, or subsidise, or at least not obstruct, MaaS services to achieve technical compatibility, critical mass and commercial viability if that support would contribute to other transport policy objectives or broader public policy goals (e.g. equity of access to transport).

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[3] A number Australian state governments have adopted a consumer-centric approach to transport policy. For example, in the Queensland Transport Strategy, the Queensland Government states that: "Queenslanders are at the heart of this strategy" (Queensland Government 2020, p.9).

[4] iMOVE has sponsored frictionless ticketing research. See here: https://www.transport.nsw.gov.au/data-and-research/research-hub/research-and-evaluation-projects/frictionless-ticketing-for-public

[5] In a market without negative externalities, profit is an indication of positive social welfare since consumers value the output at more than its opportunity cost, making society is better off.

This means that a key commercial challenge facing MaaS is to determine whether provision of bundled services adds benefits for customers compared to purchasing each mode separately and/or using a private vehicle. It is uncertain whether the increased convenience and functionality of using a MaaS platform is, by itself, enough to change travel behaviour. This question would be best resolved by further government sponsored or supported trials in Australia or overseas.

In Australia, public transport services (i.e., heavy and light rail, and buses and ferries) are generally provided at well below cost recovery. For a traveller, this provides a price over privately provided services such as ride-hailing and ride-sharing. However, the reality of a heavily subsidised public transport service means that a MaaS commercial model needs to integrate with, rather than try to duplicate or bypass, the existing local public transport system. This then, indicates a need for strong public-private cooperation.

Identifying the MaaS characteristics that consumers value, and quantifying their impact on travel behaviour is also crucial to understanding where and how MaaS will ultimately fit within the overall transport landscape. This type of behavioural research was crucial to understanding the long-term (or structural) impacts of Covid-19 on transport networks, which is, in turn, so vital for transport investment planning.

For example, one area of research could be to better understand the impacts of an ageing population on mobility demand. People living well into their late 80s and 90s (and beyond) may be less willing (or able) to rely on their own private vehicle to get to appointments and undertake domestic duties like grocery shopping. And it is likely that current retirees and subsequent generations will expect more sophisticated and nuanced transport options to satisfy higher expectations (supported by higher retirement incomes) than in past generations. In other words, as life expectancy increases and health care and entertainment options increase, it is no longer okay to expect the elderly to 'age in place' in their home or an aged care facility just because they no longer drive a car. The regional NSW projects focussed on this issue of social exclusion.

Finally, there are important challenges related to commercial risk sharing. A public transport service, which is, generally, already limited in its fare revenue capacity by regulation, will find it problematic to offer an attractive margin to a potential MaaS platform partner. Moreover, it would be difficult for a MaaS platform to charge a significant premium above its costs as individual public transport service. This acts as a competitive constraint (i.e., they are substitutes to the MaaS platform). Therefore, sophisticated bundling and pricing strategies such as combining transport and non-transport services will likely be the key to unlocking consumer value and enabling the MaaS platforms to be profitable (or at least financially sustainable).

In summary, the commercial factors germane to establishing and maintaining a profitable MaaS platform involve:

(i) High Initial Investment Costs: The start-up costs can include the development of integrated software platforms, planning the integration of various transport services networks, acquisition of necessary office space and hardware, legal and regulatory costs, and initial marketing efforts.

(ii) Achieving Sustainable Profitability: MaaS is a complex ecosystem involving many stakeholders, including public transport operators, private transport service providers, and technology providers. Coordinating among these stakeholders and creating a business

model that provides sustainable profitability for all parties over the long-term can be challenging.

(iii) Reliance on Public Funding and Subsidies: In many cases, and particularly in the various MaaS trials, the business model has relied heavily on public funding and subsidies (whether direct or indirect via a government-funded third-party entity).

To overcome these challenges, several strategies can be implemented. One potential commercial option is to form public-private partnerships, especially given the public interest in environmental sustainability and mobility equity. These partnerships can leverage the resources and capabilities of both the public and private sectors, reducing the financial burden on a single party. In terms of achieving sustainable profitability, innovative business models and, relatedly, revenue diversification should be explored. This might include moving towards a Mobility as a Feature (MaaF) model which offers a broader array of services than transport, such as food and grocery delivery or parcel delivery and even health services into the MaaS platform.

Legal and regulatory factors

Establishing MaaS platforms can raise complex legal and regulatory issues. MaaS sits at the intersection of public and private sector transport services provision and involves coordinating different transportation services often with different legal structures, data handling, user privacy, regulatory compliance, and liability considerations. In Australia, state and territory governments own and control public roads and rail lines. The public sector owns and maintains data in relation public transport demand, although many of these datasets are now freely available under open data policies. However, most current transport regulations and pricing models are not designed to accommodate this new paradigm of shared and integrated transportation. This can lead to issues in licensing, pricing, liability, data sharing, competition, and even labour laws.

In summary, the legal and regulatory challenges of establishing and maintaining a profitable MaaS or MaaF platform involve:

(i) Regulatory Compliance: MaaS platforms may need to comply with a range of local, national, and international regulations governing transportation, data protection, environmental regulations and consumer rights. Regulations governing competition, licensing, permits and approvals can vary significantly from one jurisdiction to another and can affect areas such as licensing, insurance, pricing, and accessibility.

(ii) Data Privacy and Security: MaaS platforms handle a vast amount of personal and sensitive data from users, including location, payment information, and travel history. Ensuring compliance with data protection laws and implementing robust security measures to safeguard these datasets is crucial to maintain user trust and avoid potential legal consequences in case of data breaches.

(iii) Liability and Insurance: MaaS platforms often involve multiple service providers, such as ride-hailing companies, public transport agencies, and shared mobility operators. Determining liability in case of accidents or incidents involving different services can be complex and may require clear contractual agreements and insurance arrangements, which can be costly to design.

(iv) Intellectual Property: The MaaS platform itself and any associated software, algorithms, or proprietary technology may be subject to intellectual property rights. Ensuring that the platform's development and usage do not infringe upon others' intellectual property rights is essential to avoid legal disputes.

(v) Accessibility and Inclusivity: MaaS platforms may be required to consider accessibility requirements for users with disabilities, which can vary across jurisdictions. Ensuring that the platform and associated services are accessible to all users can help prevent legal issues related to discrimination and accessibility violations.

(vi) Cross-Border Operations: If the MaaS platform operates in multiple countries or jurisdictions, additional legal complexity can arise due to the varying regulatory landscapes and legal requirements in each location. In Australia, urban areas cut across the Queensland-NSW border at Coolangatta-Tweed Heads, at the NSW-ACT border at Queanbeyan-Canberra and the NSW-Victorian border at Albury-Wodonga.

To address these legal and regulatory challenges, it is crucial for the operators of MaaS platforms to work closely with their own legal experts and regulatory and competition policy authorities to ensure compliance and build a sustainable and legally sound business model. Governments should consider supporting MaaS trials, revising or developing new regulations that facilitate MaaS while ensuring fair competition and consumer protection. Clear guidelines should be established for the roles and responsibilities of both public and private sector players. This can be achieved through public-private partnerships that define terms of collaboration, revenue sharing, and risk management. Finally, policymakers should ensure that their approach is flexible and adaptable, given the rapid pace of technological change. Regular review and revision of policies and regulations will be key to ensuring that they remain relevant and supportive of the MaaS concept.

Conclusions

The MaaS trials in Australia and overseas, and existing commercial operations in Europe and North America, have demonstrated the technical feasibility and, to an extent, the consumer value of MaaS. However, whether MaaS services can be commercially viable without public investment remains an open question. The experience thus far has also highlighted the technical, commercial, legal and regulatory complexity of providing a multi-modal (and private/public) bundled transport service via a digital platform app.

MaaS aims to improve mobility, improve equity of transport services access, and achieve environmental sustainability objectives by reducing private car ownership, decreasing traffic congestion and accidents, and lowering transport emissions. However, despite the growing interest in MaaS, there are several challenges that need to be addressed to support its widespread adoption.

To be valued by users, MaaS needs to offer an incremental benefit beyond existing transport services and journey planner applications. For example, visitors and tourists who are less familiar with the available travel options may derive substantial benefit from a MaaS offering. However for local residents, who are already familiar with their local travel options and know how to combine them without relying on an app, MaaS needs to provide additional value or attributes to make its use more appealing and preferable to using independent combinations of the private car and individually purchased transportation services.

Notwithstanding these challenges, MaaS has the potential to change the way we get around in those geographic areas that exhibit both population and transport network density. There could also be a role for MaaS in regional areas, where the private car will likely remain the critical mode of transport for most households, however this value proposition is less clear.

As technology and commercial models become more sophisticated, MaaS is expected to find initial use in Australia's capital cities. By evolving into a MaaF-type service, where a single digital platform provides not only transport services but closely related services like parcel and grocery delivery, and services where it makes sense to bundle offers into a single package, the concept may gain significant market share.

In summary, there are four core challenges to MaaS expansion globally and in Australia:

(i) Infrastructure, Integration and Interoperability: A major challenge in implementing MaaS in a new region is the lack of adequate digital platform infrastructure and integration among transport providers. Many cities are still grappling with outdated infrastructure and a lack of standardisation, which is ill-equipped to support the high-tech requirements of MaaS.

(ii) Data Privacy and Security Concerns: As MaaS relies heavily on user data, the issue of data privacy and security is important. Customers need to trust that their personal information, location data, and payment details are secure. However, with recent high-profile cases of data breaches and misuse of user information (e.g. Optus and Medibank in Australia), whether accidental or deliberate, it may become increasingly difficult to guarantee that MaaS platforms can maintain acceptable privacy and security standards.

(iii) Commercial Business Models: In the start-up phase, many MaaS providers have relied on public funds and/or temporary TSP discounts, and/or venture capital funding while the provider tries to establish sustainable revenue streams. As investors eventually seek returns on their investments, these services could become unaffordable for the average customer.

(iv) Negative Environmental Impact: In theory, MaaS can improve environmental outcomes via the reduction in private car use. However, it does depend on the suite of transport services utilised. If MaaS shifts people out of public transport onto ride-hailing services, for example, it could contribute to greater congestion and emissions (unless all ride-hailing is via electric vehicles, although even there it depends on the suite of power generation technologies supplying the NEM). Additionally, the production and disposal of electric scooters and bikes used in shared mobility services can generate waste and pollution. MaaS could also induce latent demand via increased convenience and its effect in reducing congestion. However, on balance, these concerns are likely to be overstated.

The evolution of MaaS is likely to continue with the emergence of Mobility as a Feature (MaaF). This idea holds the promise of a transition from the multi-modal approach offered by MaaS to a more expansive multi-service model, encompassing a wider array of offerings. To seamlessly integrate MaaF into diverse applications, a modular approach to deployment becomes essential. The most significant challenge lies in deeply understanding end users, ensuring that the mobility feature provides added value and genuinely enriches the user experience. In the future, MaaF may not necessarily require a transport based digital platform, but could, at least in theory, find a foothold in nearly any domain.

Policy recommendations

The following observations and policy recommendations have been developed by Tulipwood Economics based, in part, on the iMOVE sponsored MaaS research.

From a public policy perspective, governments should neither restrict nor encourage commercial activity unless there is a compelling reason to do so. In relation to MaaS, there are two compelling reasons for governments to support or, at the very least, not restrict the development of MaaS platform services.

> First, MaaS can contribute to environmental goals by lowering GHG emissions through a reduction in private vehicle use.
> Second, MaaS can contribute to mobility access and equity goals in relation to people with mobility challenges such as the elderly and the wheelchair-bound.

If Australian state governments wish to utilise MaaS (or MaaF) to achieve these two important public policy goals they could judiciously consider supporting further trials and upscale existing initiatives in Queensland and NSW. At the same time, governments should remove any legal or regulatory barriers to MaaS platform development, rollout and uptake.

Related to this, state governments could consider targeting higher levels of (operating) public transport cost recovery over time where it is clear commuters value a particular public transport service mode or line. Not only is this sensible from a fiscal policy perspective (given the alternative uses of public funds and the deadweight economic cost of raising taxes), but the measure would also send a more accurate price signal in terms of investing in and further developing quality public transport services, which form the essential backbone of the MaaS service offering in urban and metropolitan contexts.[6] It would also increase the likelihood that MaaS service providers and transport service providers would be able to negotiate commercially viable contracts to supply fixed price bundled MaaS services to consumers.

Table E – 1 sets out recommendations for further action made by Tulipwood Economics and iMOVE. The recommendations are informed by the findings and recommendations made in the iMOVE sponsored research projects — in particular Vij et al (2020) — as well as a survey of the international evidence and previous work Tulipwood Economics has undertaken for the Commonwealth and state governments related to transport policy.

TABLE E – 1 POLICY RECOMMENDATIONS

Policy objectives	Recommended actions
Transport policymaking	1. Transport policy should adopt a customer-centric, evidence-based and location specific focus that is open to the continued evolution of MaaS and MaaF as transport concepts.

[6] In contrast to the urban context, local access public transport is unlikely to be the backbone of regional and rural MaaS. However, long distance public transport will continue to form the backbone in regional and remote areas and is likely to be an important component of the MaaS offer. See, for example, Mulley et al (2023).

Policy objectives	Recommended actions
Transport services should be customer focussed and fit-for-purpose	2. MaaS policy should be iterative and adaptive with strong communication with the public and engagement of users and non-users (e.g. awareness campaigns).
Digitisation and digital integration Transport services are integrated across planning, booking and payment functions	3. The Commonwealth, state and local governments should continue to support data integration and data sharing via existing open data policies and work towards full digitisation and integration of public transport services state-wide (focussing on connecting regional and remote centres), and keep the public transport network open to private sector integration. Interstate compatibility is important at Australia's numerous cross border urban areas. 4. An Australian Competition and Consumer Commission (ACCC) sponsored industry code of practice based on the recently developed UK model to encourage transport operators to digitise and share operational data should be considered.[7] 5. State transport departments should establish systems for data analysis from MaaS usage and experiences, to be able to inform future transport investments and land use planning decisions based on customer experiences and network demand management data.
MaaS integration with policy and planning Public sector incentives and instruments are integrated in service offering	6. State governments should consider implementing at least one full-scale network-wide MaaS pilot each in a metropolitan and regional centre with provision for evaluation and monitoring built in. 7. State governments should review public transport fare and ticketing policies to potentially allow for dynamic and differentiated pricing, and resale by third-party vendors. 8. State governments should share with each other their assessments of all future MaaS pilots across all potential impact dimensions. 9. Develop coordinated strategies and roadmaps with other policy sectors important for the successful operation of MaaS, notably:

[7] https://www.gov.uk/government/publications/mobility-as-a-service-maas-code-of-practice/mobility-as-a-service-code-of-practice

Policy objectives	Recommended actions
	urban and regional planning; health (i.e. mobility and access); treasury and finance, and decarbonisation.
Governance MaaS activities across government and industry are appropriately managed and coordinated	10. Consult with local councils to discuss how the operation of MaaS could be supported in the regions and how to encourage the use of non-private vehicle transport. 11. Through engagement by transport authorities with mobility constrained Australians (e.g., people with disability, vulnerable Australians, people in rural, regional and remote Australia) ascertain the benefits that a MaaS service could deliver. 12. Ensure that any future MaaS trials and pilots be accompanied by communication with the public, to both inform them and obtain feedback to measure progress towards policy objectives and to refine future MaaS offerings.
Public transport cost recovery	13. Work towards increased (operating) cost recovery over time on those public transport modes and routes that consumers value, to create financial capacity to establish a commercially viable MaaS offering.

Introduction

About this review

The iMOVE Cooperative Research Centre (iMOVE) has asked Tulipwood Advisory Pty Ltd (Tulipwood Economics) to provide an overarching report summarising iMOVE's Mobility as a Service (MaaS) sponsored research projects and to provide policy recommendations that could support the development of MaaS in Australia.

iMOVE is a national transport R&D hub established in 2017, funded through the Australian Government's Cooperative Research Centre (CRC) Programme for a ten-year period. iMOVE co-funded five MaaS related projects between 2018 and 2023, as follows:

TABLE E - 2 IMOVE SPONSORED MAAS PROJECTS

Number	Project name	Project lead	Project completion
1.	MaaS and On-Demand Transport - Consumer research and report.	ITSA	June 2018
2.	MaaS business models: Emerging business models in the digital economy, and lessons for Mobility as a Service (MaaS) operators and regulators.	UniSA TFNSW	June 2020
3.	Mobility as a Service (MaaS) Trial: User Behaviour Analytics.	ITLS	June 2021
4.	Odin Pass: a Mobility-as-a-Service (MaaS) Trial at UQ St Lucia.	UQ	June 2023
5.	Design of a Regional Town and Rural Hinterland (RTRH) MaaS Blueprint.	ITLS, TFNSW	June 2023

Source: iMOVE CRC (supplied).

In addition to these five projects, two PhD candidates that have been sponsored by iMOVE were interviewed about their MaaS dissertations, as follows:

> Thiranjaya Kananaarachchi (University of Sydney) — How can we build Trust and Collaboration among Mobility as a Service (MaaS) Stakeholders?
> Nikhil Chand (RMIT) — Integrating MaaS into public transport journeys for users with a focus on vulnerable travellers.

More recent MaaS academic and industry/government research material was also reviewed, including in relation to current overseas trials and commercial operations.

Structure of this report

The report structure is set out in Table 0-1 Report structure.

TABLE 0-1 REPORT STRUCTURE

Section #	Title	Details
-	Executive summary	Executive summary
1	Introduction	Provides a brief introduction to the review
2	Conceptual framework	Provides a public policy framework within which to consider the benefits and challenges of MaaS platforms.
3	Australian MaaS trials	Summarises the design and outcomes of the Australian MaaS trials.
4	Overseas developments	Summarises the overseas trials. Summarises the overseas commercial operations.
5	Future prospects	Considers the future prospects for MaaS in Australia.
	References	
-	Appendix A	Summarises the economic theory of bundling as it relates to MaaS platform services.
-	Appendix B	Lists the MaaS research papers reviewed, including the iMOVE-sponsored papers and other papers.

MaaS conceptual framework

What is MaaS?

There has been debate in academic and policy circles around the best characterisation of MaaS, especially in the early stages of its development in the 2010s. In its essential form, MaaS is a strategy that consolidates various forms of transport services into a single on-demand mobility service. The primary aim of MaaS is to provide convenient and efficient transport solutions that can compete with the comfort and convenience of a private car. This is not to say that successful MaaS platforms can't operate under certain conditions in a world of almost universal private car ownership. From a public policy perspective, MaaS can be defined as an emerging strategy to reorganise transportation services in order to tackle: (i) mobility and (ii) sustainability challenges via, in part, by offering an alternative to private vehicle ownership.

MaaS is, therefore, a two-pronged concept. First, it is a consumer-centric model of people transportation, which treats mobility as a consumable service. Instead of owning and managing personal vehicles, MaaS relies on digital platforms to integrate various modes of transportation – including public transit, ride-hailing services, car-sharing, bike-sharing, and autonomous vehicles – into a single, accessible service. Second, MaaS is a public policy tool to achieve societal outcomes related to equity and environmental sustainability (Box 0-1).

BOX 0-1 DEFINITION OF MOBILITY AS A SERVICE

A concise definition of MaaS has been provided by Nelson et al (2023), as follows:

> *A type of service that, through a joint digital channel, enables users to plan, book and pay for multiple types of mobility service.*

A longer and more detailed definition has been provided by Hensher et al (2021, emphasis in bold added), as follows:

> *MaaS is a framework for delivering a portfolio of multi-modal mobility services that places the user at the centre of the offer. MaaS frameworks are ideally designed to achieve sustainable policy goals and objectives. MaaS is an integrated transport service brokered by an integrator through a digital platform. A digital platform provides information, booking, ticketing, payment (as PAYG and/or subscription plans), and feedback that improves the travel experience. The MaaS framework can operate at any spatial scale (i.e., urban or regional or global) and cover any combination of multi-modal and non-transport-related multi-service offerings, including the private car and parking, whether subsidised or not by the public sector.*
>
> ***MaaS is not simply a digital version of a travel planner, nor a flexible transport service (such as Mobility on Demand), nor a single shared transport offering (such as car sharing).***

'Emerging MaaS' best describes MaaS offered on a niche foundation. This relates to situations where MaaS is offered on a limited spatial scale, to a limited segment of society or focused on limited modes of transport. The MaaS framework becomes mainstream when the usage by travellers dominates a spatial scale and the framework encompasses a majority of the modes of transport.

Source: Nelson et al (2023) and Hensher et al (2021).

MaaS platform services occur along a spectrum of transport services integration. For example, the degree of integration can comprise:

- Integrated booking or ticketing, e.g. a 'smartcard' or a mobile app that can provide access to different modes;
- Integrated payment or invoicing;
- Organisational integration. That is, collaboration between different transport providers (car- and bike sharing, taxi, bus, train, etc.); and/or
- Bundling, which entails a time-limited subscription to trips with different modes.

Alternatively, MaaS platform services can be characterised from the customer perspective. Important aspects include:

- How well the service meets a customer's entire mobility needs (including accessibility and door-to-door solutions);
- What transport services are included and where they are located (breadth of service);
- Bundling/packaging options, flexibility (easy to modify, minimal lock-in effects, etc.), value for money;
- Low-risk trialability;
- Customer support, personalisation and customisation, decision support (e.g. travel planning), ticketing and payment solutions (easy to book/modify/authenticate and pay), usability (both the interface and how easy it is to understand the offer, pricing, etc.); and/or
- Data security and protection (ownership, sharing, etc.), liability and guarantees.

From the technical perspective, the following characteristics are relevant to defining MaaS:

- Information/planning function at different levels: (a) 'only' centralised information, (b) multimodal travel planner, and (c) virtual assistant (i.e. the App takes into account one's schedule);
- Sophistication of APIs and platforms (both front and back-end solutions), including payment solutions technology;[8]
- Data analysis, integration with existing systems; and
- Type of user interface.

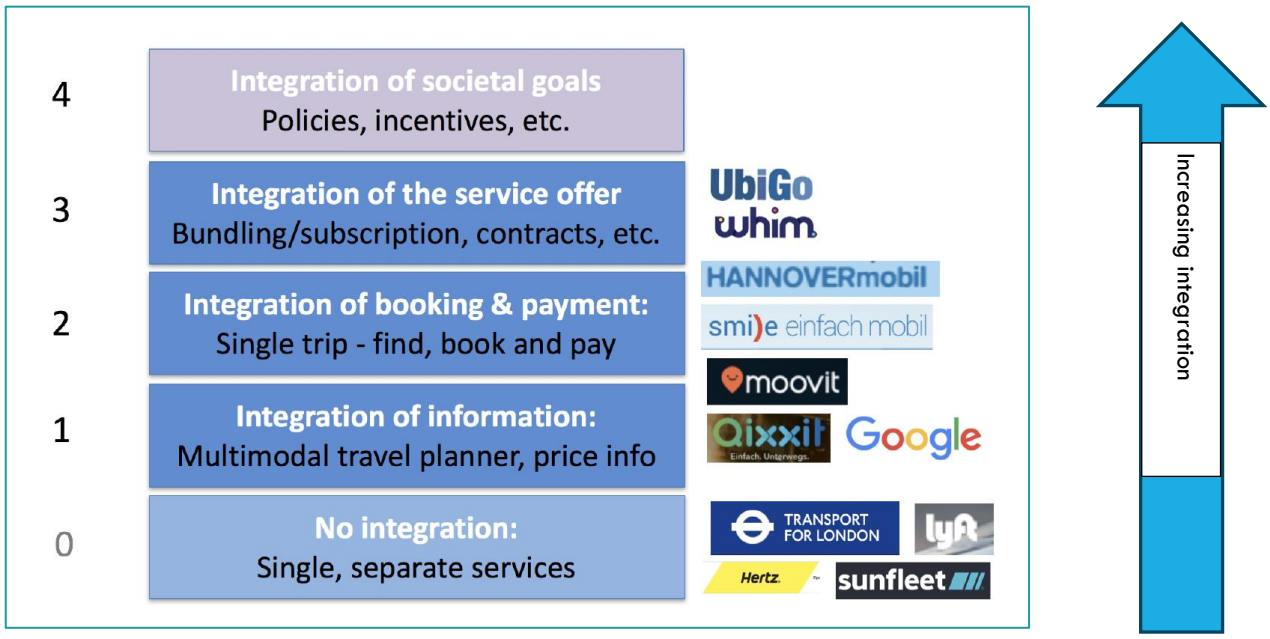
MaaS platform services, therefore, can be thought of as range of service offerings from a minimum level of additional customer value above current available services to a fully integrated offer that potentially

[8] An API is an Application Programming Interface.

provides significant additional customer, and societal value. Sochor et al (2017) proposed a topology consisting for four levels.

The four levels framework characterises the progression from merely providing information (Level 1) to facilitating transactions (Level 2), offering comprehensive bundled services (Level 3), and finally aligning mobility services with societal goals (Level 4). Figure 0-1 illustrates the topology of MaaS platforms.

FIGURE 0-1 TOPOLOGY OF MAAS PLATFORMS



Source: Sochor et al (2017).

Where and how does MaaS fit in?

Passenger transportation in Australia is a hybrid system of mainly publicly owned transport networks, and public and private transport service provision. Publicly provided services such as heavy and light rail, buses and ferries provide a significant proportion of passenger movements in Australia's capital cities and are heavily subsidised by the taxpayer to reduce the social costs of congestion and environmental pollution. That said, private car use still dominates passenger transport in Australia, especially in regional and remote Australia where there are fewer public transport options.

MaaS platform services can be thought of as a new transport offering that provides an incremental improvement in the passenger experience beyond existing services. From the perspective of transport providers, MaaS may increase overall demand, reduce operating costs and increase profitability. From the government perspective, MaaS can be utilised to achieve public policy goals related to equity, accessibility, and environmental sustainability. The mechanism to achieve these multiple goals is related to the concept of service bundling.[9]

[9] The economic theory of bundling is discussed in detail at Appendix A.

What are the benefits of MaaS?

While the purported benefits have remained largely elusive thus far, a well-designed MaaS can potentially provide customers with a number of advantages over purchasing mode-specific transport services separately, including greater convenience, more choice, improved and/or more equitable access, and reduced annual travel costs. To the extent that a MaaS service eliminates the need for a person to purchase and maintain their own private vehicle, and/or reduce trips by private vehicle, the savings could be significant.

Increased MaaS adoption can potentially reduce private car ownership by giving people greater confidence in their transport options, thereby decreasing congestion, traffic incidents, and contributing to environmental goals via reduced GHG pollution. From a public policy perspective, these three social costs of private car use can justify governments charging for public transport services at below full cost recovery (i.e. using tax revenue to fund public transport services) while still achieving a socially beneficial outcome.

Enhanced User Experience and Convenience

One of the main advantages of a MaaS platform is its ability to offer a superior customer experience. By integrating various transport options, such as public transport services, ride-hailing, car-sharing, and bike-sharing, MaaS platforms enable customers to plan, book, and pay for their trips using a single app.

A 2018 study led by Intelligent Transport Systems (ITS) Australia, in collaboration with several industry and government organisations including iMOVE and the University of South Australia, sought to understand how consumers would value these potential benefits (ITS Australia, 2018). The study involved interviews with over 80 leaders in the transport and technology sectors, which informed the development of a customer survey. This survey was completed by 4,000 Australians, selected to be demographically representative of the country's urban, regional, and rural areas. The interviews and survey process were guided by six key questions:

(i) What MaaS is;

(ii) What are the challenges;

(iii) What are the opportunities;

(iv) The potential impacts;

(v) Considerations for deployment; and

(vi) Customer expectations.

The study found that, in 2018, MaaS was a new concept to most Australians, and perceptions were likely to evolve as more on-demand transport options are introduced and MaaS systems are experienced firsthand.

The survey revealed a strong interest in MaaS products from younger respondents although PAYG schemes were twice as popular as prepaid unlimited access schemes, perhaps reflecting an unfamiliarity and uneasiness with this new model. Survey respondents had no strong preference as to whether

government or private operators delivered MaaS products, although there was more support for schemes where government oversight was involved.

The survey identified important MaaS features for customers, such as access to real-time information, incentives to change travel behaviour, and increased safety and security. Respondents indicated that they would likely be receptive to MaaS systems implementing travel demand management strategies.

The survey also revealed that car owners often underestimate the total operational and day-to-day costs of maintaining private vehicles. While the average cost of running a car is approximately $12,000 per year (in 2018), according to the survey, most Australians believe it is $5,000 or less per year. This finding is relevant because potential buyers of MaaS subscriptions would rationally compare the cost to the cost of owning and maintaining a vehicle.

The ITS Australia study concluded that there is a potential market for MaaS platforms in Australia, with potential adoption rates of between 30 and 46 per cent for pay-as-you-go access to transport modes, and even high-cost prepaid schemes showing promising adoption rates. However, high monthly subscription fees would be a barrier to low-income earners and those people receiving only welfare payments. As would be expected, the best potential regions for MaaS include the Greater Sydney metropolitan area, the Melbourne metropolitan area, South-East Queensland, and parts of regional New South Wales.

The study identified five different consumer characteristics in terms of their willingness to use MaaS. Young and middle-aged individuals, whether single or married, with or without children at home, were more likely to use MaaS. In contrast, older individuals with adult children were less willing to use MaaS. Higher levels of education and employment also correlated with increased MaaS use.

Individuals' current travel behaviour and attitudes towards existing modes of transport were significant indicators of their willingness to use MaaS. Those who rated their local public transport services poorly, were not open to car-sharing, and saw private car ownership as necessary were less willing to use MaaS. However, those with high perceived travel costs were more likely to use MaaS, suggesting that making customers aware of the total annual costs of private car ownership could increase interest in MaaS.

Key findings from the ITS Australia survey included:

- Younger respondents showed more interest in MaaS than those over 65.
- Many were interested in MaaS for social activities rather than commuting, indicating a reliance on public transport and a gap in understanding of MaaS capabilities.
- A small but significant group of early adopters showed immediate interest in MaaS, suggesting the potential for rapid expansion akin to the adoption of smartphones.
- Survey respondents strongly preferred a MaaS product that includes public transport, emphasising the need for effective integration of public and private offerings.
- Access to and integration of data was identified as a key component for the effective deployment of MaaS. Survey respondents valued real-time information and personalisation, which will rely on data sharing. However, data interoperability standards with privacy and security safeguards will need to be established.

In another study looking at how consumers perceive MaaS, Guidon et al (2020) found that public transportation, car sharing, and park and ride services were valued more when offered in a bundle rather than as standalone services confirming the findings of the ITS Australia study in a different context.

Improved industry profitability

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. Vij et al (2022) identifies six broad opportunities and challenges of MaaS platforms from the perspective of transport service providers.

- First, MaaS could strengthen potentially complementary relationships between services.
- Second, MaaS could potentially increase market demand over time through novel subscription plans that offer customers bundled access to multiple transport services.
- Third, 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.
- Fourth, MaaS could increase visibility and exposure for existing transport services, particularly those operating at smaller scales.
- Fifth, MaaS could increase utilisation rates of underused public and private transport assets.[10]
- Sixth, MaaS could reduce operator costs by outsourcing particular functions, such as ticketing, and leveraging economies of scale by integrating these functions across multiple transport modes and services.

Improved Accessibility and Equity

MaaS platforms can improve transport accessibility and equity by offering a wide range of mobility options that cater to diverse user needs. By including services such as wheelchair-accessible vehicles, discounted fares for low-income users, and user-friendly interfaces, MaaS can help ensure that urban transport systems are more inclusive and accessible. Given accessibility and equity are common public policy goals, government support for MaaS is justified.

Environmental Benefits

MaaS can contribute to a reduction in GHG emissions and particulate air pollution by promoting a shift from private vehicle use to more sustainable modes of transport. By integrating options like electric bikes, scooters, and electric vehicle-sharing services into the MaaS ecosystem, the platform can encourage users

[10] Public transport services, particularly post-Covid, have low utilisation rates. As a strategy to boost patronage and usage rates, some have suggested integrating rideshare with public transport or substituting low-traffic bus routes with rideshare. On-demand transport (ODT) trials in New South Wales, Australia, are currently exploring this approach. For instance, in Dubbo, LiveBetter operates ODT services connecting town centres using community transport vehicles. In Greater Sydney, GoGet and Keolis Downer have teamed up to run ODT trials using underutilised GoGet carshare vehicles.

to adopt low-emission transport alternatives, reducing the overall environmental contribution of transport to GHG emissions.

Wider Economic Benefits

MaaS can potentially stimulate economic growth and job creation by fostering innovation within the transport sector and promoting a more efficient use of scarce resources. The development of new services, technologies, and infrastructure to support MaaS can create employment opportunities in research, engineering, data analytics, and customer service. As a technology, MaaS also offers the prospect of continual innovation, with new business models and ways to organise and operate the various transport modes, with advantages for transport operators including access to improved user and demand information and new opportunities to serve an unmet need such as for people with disability.

Optimal business model characteristics

The MaaS ecosystem

The Mobility as a Service (MaaS) ecosystem involves various stakeholders, including:

Customer: The end-users who consume the MaaS services.

MaaS Provider (Platform Provider): The entity responsible for designing and offering the MaaS services to customers.

Data Provider: Entities that supply data crucial for MaaS operations.

Transport Operator: Organisations that provide transport services, including vehicle assets and infrastructure.

Public Authority: Often acts as a facilitator and regulator, with integrator roles in some cases. This role can vary in form depending on local governance structures.

Regulator (usually by an independent state/national government agency): Responsible for regulating and overseeing MaaS operations.

Aggregator/Integrator/Broker: Key stakeholder responsible for data and information sharing between Transport Operators and MaaS Providers. This role can be commercial or public and is central to the MaaS ecosystem.

Other Service Providers: Non-mobility operators, such as financial institutions, technology companies, and entertainment-related businesses, that may offer complementary services within the MaaS ecosystem (i.e. a MaaF commercial model).

Each of these stakeholders plays a unique role in the development and delivery of MaaS services, and their functions may vary depending on the specific context and regulatory environment. (Mulley et al, 2020).

Finding a unique value proposition

An optimal MaaS business model must be commercially viable in the long-run and benefit consumers such that they are willing to pay a price that covers the cost of the MaaS platform and deliver a return on investment to the service provider.

As noted in Section 3.2, the successful implementation of MaaS requires cooperation between multiple stakeholders, including transport providers, technology companies, government agencies, and customers. The integration of different modes of transport into a single, easy-to-use platform presents technical challenges, but it also offers enormous potential for improving mobility, reducing congestion and emissions, and making places more liveable.

For transport operators (i.e. producers of transport services) to be interested in joining a MaaS platform, and potentially integrating with other transport service providers, the MaaS platform must increase its revenue and/or reduce costs, potentially through one or more of the following mechanisms:

i. Strengthen potentially complementary relationships between services (but not threaten existing services that are in direct competition);

ii. Improve revenue management through discounted, dynamic and differentiated pricing that is targeted at specific services and customers with a higher degree of precision than is currently possible;

iii. 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; and

iv. Increase utilisation rates of underused public and private transport assets (e.g. community transport, courtesy transport, buses, carshare).

Emerging commercial models

A detailed study by the University of South Australia, supported by iMOVE and the Commonwealth Government, identified three emerging MaaS business models, as follows (Vij et al, 2018):

(i) Subscription Model: This model would operate like Netflix or Spotify. Customers pay a monthly subscription fee access to a range of mobility services. This can be divided into different levels of service, with higher tiers offering more flexibility or additional benefits. For example, Whim offers such a subscription model.

(ii) Pay-As-You-Go Model: In this model, users pay only for the services they use. It is more flexible for some customers, but could become expensive if used frequently. This model may be preferred by customers who use mobility services sporadically or have variable (i.e. irregular) transportation needs.

(iii) Integrated Services Model: This model aims to provide a comprehensive transport solution by integrating different mobility services, either owned by the MaaS provider or through partnerships with private and public service providers. In this model, a MaaS platform offers

users a single point of access and payment. Customers could have the option to pay-as-they-go or subscribe.

In terms of an integrated services model, Vij et al (2018) identified three commercial approaches.

Brokered platform

A brokered platform is where different transport operators offer their services, and the platform provider brokers individual deals. Providers charge a commission or flat fee per transaction.

In this model, commercial viability is a significant challenge. Large transport operators are hesitant to join, as integration could erode their own services. Smaller operators, although open to the platform, often lack the resources and technological capabilities for integration. Both types of operators are reluctant to share ticket revenue with a third-party MaaS platform, given their already low-profit margins (as pricing is generally regulated). Moreover, customers are unwilling to pay extra for integrated access. Therefore, Vij et al (2018) finds that without government support, the brokered platform model might not be commercially viable in the short term.

Walled gardens

It may be that large transport operators prefer to create their own MaaS platforms where they control what additional products and services are offered. Vij et al (2018) finds that the walled garden model is more likely to be commercially viable without government support, but has drawbacks. Service integration would be only partial, reducing consumer value and, potentially, enhancing the market power of some operators. Further, a rise in private sector-operated walled gardens could lead to negative societal outcomes, such as increased congestion and emissions.

Open marketplace

Facilitated by the government, this commercial model allows any transport service to be sold and resold on any MaaS platform, without formal arrangements between platform providers and transport operators. This model seeks to address the shortcomings of the other two models. However, it has faced resistance from some operators, such as rideshare services, which rely on their network of drivers and passengers as a unique competitive advantage. The open marketplace model eliminates this advantage, which led to Uber withdrawing its services from Finland, where this model was implemented. Other operators might react similarly in other jurisdictions.

Best model design

The best commercial model for MaaS will vary depending on the specific legal/regulatory and market circumstances of each location. However, some of the factors that should be considered include regulatory and ownership structure, market structure and size, range of available transportation services, and consumer preferences. The 'best' model will depend on various factors such as the maturity of the transport infrastructure, user preferences, legal and regulatory considerations, the density and diversity of transport services available, among other factors.

In general terms, Vij et al (2020) found the most viable or 'best' model design will be:

Scalable: The model should be scalable to accommodate growth in the number of users and transportation providers.

Sustainable: The model should be sustainable financially, and it should also be sustainable from an environmental perspective.

Acceptable: The model should be acceptable to users, transportation providers, and regulators.

Clearly, it is important to consider how MaaS is financed. While commercial revenues can cover some costs, public financing, private investment, or a mix of both may be necessary to cover the initial setup costs and ongoing operation. Policymakers and transport authorities will play a crucial role in shaping the MaaS landscape and help to overcome any financial, regulatory, or operational barriers.

What are the challenges?

Researchers have highlighted several challenges facing the widespread adoption of MaaS platform services in Australia, as follows.

Lack of awareness: Many people are not aware of MaaS or how it works.

Interoperability: Australia's transport systems are often fragmented, with multiple operators, ticketing systems, and modes of transportation. Lack of integration and coordination between different transport providers makes it challenging to offer a seamless MaaS experience and to maximise cooperation across operators and providers.

Financial Viability: Developing and operating a MaaS platform requires substantial investment, both in terms of technology infrastructure and partnerships with transport providers. Establishing a financially sustainable business model for MaaS can be challenging, particularly in areas with lower population densities or limited public transport options.

Cost: MaaS services can be more expensive than traditional transportation options. Therefore, the benefits of MaaS relative to traditional transport options must be clearly articulated. In other words, it needs to be made clear under what circumstances MaaS would provide net benefits relative to the next best transport service option.

Regulatory Challenges: Existing regulations and policies may not be designed to accommodate MaaS models. Legal frameworks, licensing requirements, and regulatory barriers can hinder the implementation and operation of MaaS platforms, particularly when it comes to integrating different transport modes and payment systems.

Data Sharing and Privacy Concerns: MaaS relies heavily on the availability and sharing of data between various stakeholders, including transport operators, technology providers, and government agencies. However, concerns around data privacy, security, and ownership often arise, creating obstacles to data sharing and hindering the development of comprehensive MaaS solutions.

User Adoption and Behaviour: Changing customer behaviour and encouraging people to shift from private car ownership to shared mobility options can be challenging. In many locations, people are accustomed to using their private vehicles and may be hesitant to rely on multiple modes of transport or try new services. Promoting the benefits and convenience of MaaS and addressing user preferences and concerns are crucial for increasing adoption.

Stakeholder Collaboration: Collaboration and cooperation among various stakeholders, including government agencies, transport operators, technology providers, and community organisations, are essential for successful MaaS implementation. However, differences in priorities, competing interests, and coordination challenges can impede progress.

Role of Government

Governments, as the owners and operators of public transport networks, and the regulator of private vehicle use, will play an important role in the development of MaaS platform services in Australia. The NSW and Queensland Governments have been at the forefront of exploring and progressing MaaS.

According to the NSW Future Transport Strategy 2056 and Future Transport Technology Roadmap, MaaS is integral to its future transport vision as it aligns with the state's six primary transport policy goals, including reducing congestion and environmental impacts, creating more attractive urban spaces, and improving mobility for disadvantaged groups.

NSW has encouraged private sector interest and investment in MaaS. Initiatives have included the MaaS Innovation Challenge in 2018-19 and the Contactless Transport Payments (CTP) program. Furthermore, the development of a MaaS data specification by Transport for NSW (TfNSW) facilitates the sharing of real-time information between transport operators and MaaS aggregators.

Experiences from Europe underscore the necessity for strong government involvement to maximise customer welfare and achieve long-term societal goals. Vij et al (2018) recommended that the NSW government play an active role in MaaS development to prioritise long-term societal objectives and regulate the preferred business model. Their report suggests 19 specific actions, including continuing the collaborative approach towards integrating the state's transport system, conducting pilots and trials, and developing a roadmap for implementing a fully-integrated MaaS system. The report also emphasises the need for digitising public transport services in regional areas, integrating MaaS systems and services with transport policy and control, and developing collaborative governance approaches.

Vij (2020) also underscored the important role governments can play in managing MaaS, with particular focus on examples from Finland, Netherlands, Sweden, and Germany where government involvement has been crucial. Their analysis highlighted the necessity of the NSW Government's proactive role in the operation and development of MaaS, with TfNSW playing a key role. The government should clarify the level of integration it envisions for MaaS, and how societal goals can be integrated. Finally, Vij (2020) identified several policy instruments that could enable and regulate MaaS in NSW. They include strategies/action plans, collaboration, financing, and regulation. It stresses that collaborative policy agendas should be negotiated, with collaborative governance being central for designing collaboration and distributing responsibilities.

In Queensland, the Department of Transport and Main Roads (TMR) and The University of Queensland (UQ) sought to understand how Mobility-as-a-Service (MaaS) schemes could enhance personal mobility, with a particular focus on increasing patronage of public and active transport. They view MaaS as an avenue for increasing the attractiveness of public transport in the face of competition from new and future transport modes that may adversely affect the transport system, primarily through increased congestion. Additionally, MaaS can provide consumers with greater exposure to a range of active transport/micro-mobility options. Access to/from public transport routes, as well as pricing, as seen as two major barriers to increased public transport patronage.

UQ also has a particular desire to increase the fairness of personal mobility options for its students and staff, such that those who cannot necessarily afford to live close to campus are not unfairly disadvantaged by public transport pricing, and in turn, forced to use private transport more often. By first surveying UQ students and staff, and then providing them with the opportunity to participate in a real-world MaaS subscription trial they explored how a shift away from pay-as-you-go transport pricing to fixed-cost pricing (mobility plans), may affect travel behaviour. The data collected through this project was used to assess whether a sustainable business model for MaaS subscriptions could be developed that would enable the concept to be explored beyond the UQ St Lucia campus.

Summary

Implementing MaaS often requires a cultural shift, both among users and within the transportation industry. Encouraging a mindset change towards shared mobility, emphasising the benefits of sustainable transportation, and promoting the value of integrated transport systems may be a gradual process.

Addressing these barriers requires comprehensive strategies involving policy reforms, regulatory updates, investment incentives, public awareness campaigns, and collaborative efforts among stakeholders. Overcoming these challenges is crucial to realising the full potential of MaaS and improving transportation options and sustainability in Australia.

Government involvement is crucial, not only because governments are active participants in the transport market, but also because MaaS can progress important public policy goals. From a commercial perspective, sophisticated and nuanced bundling of options will be the key to a viable and sustainable commercial model.

Case studies: MaaS developments in Australia

Introduction

A number of MaaS trials have been undertaken in Australia in recent years. These trials have been supported by government and industry partners and have sought to understand the potential technical and commercial viability and economic and social benefits of MaaS platform services in the Australian context.

The NSW and Queensland governments, in particular, have been supportive of exploring the viability and benefits of the MaaS concept. Government supported initiatives have focused on facilitating integration between planning, booking and payments functions across different publicly operated public transport services.

The NSW Government, for example, has supported:

- Open data policies: TfNSW currently provides both planned and real-time General Transit Feed Specification (GTFS) data for all public transport services operating in Sydney[11];
- Public transport smartcard: Opal smartcard offers introduced in 2012 integrated access to all public transport in Sydney, the Blue Mountains, Central Coast, the Hunter and the Illawarra;
- MaaS data standards: TfNSW has developed a data specification for the sharing of planned and real-time information between operators and aggregators;
- Multimodal journey planner: TfNSW is currently trialling Trip Planner, a multimodal journey planner that will allow consumers to plan and book public transport, taxis, rideshare, cycling and walking services state-wide;
- MaaS innovation challenge: TfNSW's Transport Digital Accelerator incubated multiple MaaS pilots operated by the private sector in Sydney in 2018-19; and
- Contactless ticketing: Since the summer of 2019-20, public transport customers in NSW have been able to use debit/credit cards or linked devices as a replacement for Opal smartcards.

[11] GTFS is an open data standard used to distribute relevant information about transit systems to riders. See here for further information: https://gtfs.org/

The Sydney MaaS trial

Trial design and objectives

The Sydney MaaS trial was Australia's first, commencing in April 2019 and ran for two years. The trial's objectives were to understand MaaS platform user experiences, impacts on travel behaviour and potential commercial viability. The trial's design was informed by earlier European MaaS trials, focusing on understanding which transport services should be included in a MaaS platform and how those services should be bundled. The challenge was to devise mobility bundles that encourage sustainable transportation habits, reduce car use (and $CO2_e$ emissions), while at the same time being commercially viable. It was recognised that subscription plans with financial discounts have the potential to change travel behaviour.[12] In essence, the purpose of the trial was to understand how much appeal there is for particular integrated mobility services offerings, be they Pay as you Go (PAYG) or subscription-based, and what implications they may have on travel behaviour as well as broader societal impacts.

The trial comprised many steps and specific tasks, such as designing a MaaS platform app (the Tripi App), working closely with transport service providers to facilitate service integration, promoting the trial, running pre-trial surveys, onboarding participants, data capture and analysis, and post-trial evaluation.

The design process was iterative and utilised customer demand data from the Tripi App, which was developed by SkedGo specifically for the trial, the Safer Journeys program for car users[13], online surveys, and one-on-one interviews with customers. Several mobility bundles with varying incentives were introduced during the trial, and their impacts on travel behaviour were assessed.

The Sydney trial established commercial contracts between IAG (acting as the broker of the bundles and employee of the participants involved in the trial) and transport service providers like Uber, Cabcharge, GoGet, Thrifty Car Rental, and Opal card electronic ticketing (i.e. the public transport service). In general, securing participation from transport service suppliers proved to be challenging. The trial also considered including e-scooters, bikes, and private car-sharing platforms but this proved to be problematic due to security concerns related to customer credit card information.

The Tripi App allowed users to see possible routes and costs for trips from point A to point B for most transport service options. Users could book a trip directly from the app. IAG as the broker facilitated all payments. Users could see all trip costs and pay the broker monthly. For Opal users, cards were purchased by IAG for the trial participants, and the expenses were directly billed to IAG. Uber, Cabcharge, GoGet, and car rental payments were all set up similarly, with participants added to a central account, trips logged, and IAG billed monthly. Reports on trips and associated costs were either automatically logged via Application Programming Interfaces (APIs) or manually entered into a backend system.

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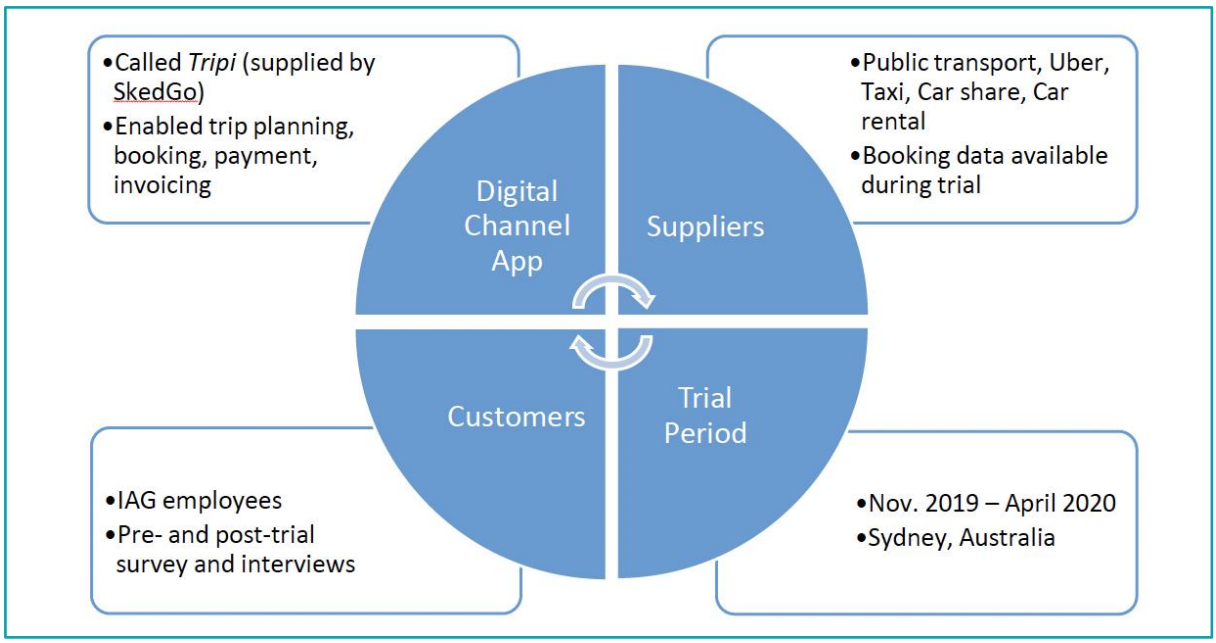
[12] See discussion on bundling at Appendix A.

[13] A complementary program called Safer Journeys, run by IAG, involved some participants' cars being fitted with tracking devices for rapid incident response, enabling the trial to assess the influence that MaaS has on private car use.

Figure 0-1 describes the main design features of the Sydney trial.

FIGURE 0-1 SYDNEY MAAS TRIAL DESIGN



Source: Hensher, Ho, Reck and Smith (2020, p.6).

Arguably the central challenge of the Sydney trial was to design MaaS bundles that met potentially contradictory goals — that is, meeting customer demand and providing value for money, providing a return to the MaaS platform business, meeting cost recovery and profit requirements of service providers, and meeting access and environmental sustainability public policy goals.

The trial introduced bundles gradually, with an initial Pay-As-You-Go (PAYG) only period. The study used data from a pre-trial survey and from actual travel behaviour and participant feedback to design subsequent bundles. The bundles introduced over different months were 'Fifty50', 'Saver25', 'GreenPass', and 'SuperSaver25'. By March 2020, 46 per cent of participants had opted for bundles. Of these, 15 per cent chose Fifty50, 12 per cent selected SuperSaver25, and 19 per cent picked GreenPass (reflecting consumer preferences for sustainable travel options). Figure 0-2 lists the essential characteristics of each bundle.

FIGURE 0-2 BUNDLES OFFERED IN SYDNEY MAAS TRIAL

Source: Hensher, Ho, Reck and Smith (2020, p.24).

The trial established a base case of mobility activity so that changes in travel behaviour could be estimated and analysed. The data obtained prior to the trial gave insights into the modal mix and frequency of transportation modes and revealed a high occurrence of multimodal behaviour with individuals using a combination of public transport and cars or public transport, cars, and taxis/Ubers. Many of the potential participants lived close to public transport.[14] A smaller fraction showed unimodal behaviour, i.e. using only cars or public transport. In terms of frequency, many respondents use public transport frequently (daily or 3-5 times a week). Car usage frequency varied significantly, with categories including daily users, frequent users (3-5 times/week), and infrequent users (1-2 times/week). Car rentals and car shares were much less popular, but rideshare (especially Uber) frequency was high. Taxis were used less frequently than Ubers.

Implementation required a mix of technological proficiency, market research, user experience analysis, and feedback integration. A number of steps were involved and lessons from these included:

(i) Technological Integration: Ensure that all transportation modes are seamlessly integrated into the MaaS platform so that users can shift between modes effortlessly.

[14] Notably, participants were not selected based on age, income levels, typical types or trip, trip times or whether they owned cars. Given they were recruited from a single employer there could be biases since there would be no school age children (who may not pay for their own transport and who do not drive cars but may be driven in them) and young adult students in the trial and also potentially a lower percentage of non-working age people.

(ii) Pilot Testing: Prior to a full-scale launch, select a smaller group of participants to test the bundles to provide valuable insights into possible challenges that might arise and identify areas of improvement.

(iii) User Onboarding: Engage participants with tutorials, FAQs, and customer support, so they are familiar with how the bundles work, especially if the bundles have complicated components.

(iv) Feedback Mechanisms: Introduce real-time feedback systems that allow users to report issues or provide suggestions. This feedback loop proved to be crucial, especially during the initial phases.

(v) Monitoring: Deploy analytics tools to monitor user behaviour to identify which bundle components are the most popular, which were overlooked, and the patterns of travel under the bundle subscription.

(vi) Financial Tracking: Regularly assess the financial implications of the bundles. Are they sustainable from a revenue point of view? Are users seeing enough financial benefits to warrant their continued subscription?

Trial evaluation

The trial used a continual evaluation methodology that tracked a number of metrics, as follows:

- User Satisfaction: Periodic surveys were undertaken to gauge user satisfaction levels. What aspects of the bundle do they find most beneficial? What could be improved?
- Financial Evaluation: This analysed the 'financial health' of the bundles. Are they proving to be economically viable for both the providers and the users?
- Environmental Impact: This evaluated the impact of MaaS bundles on environmental objectives such as reducing $CO2_e$ emissions due to reduced car usage and/or increased public transportation patronage.
- Modal Shift Analysis: This assessed if the MaaS bundle had influenced users to opt for more sustainable modes of transport or if car dependency remained unaffected.
- Adaptability: This assessed how quickly and efficiently the system adapted to changes. This could be changes in user behaviour, introduction of new transport modes, or societal changes such as global pandemics (i.e. the impact of Covid-19).
- Lessons Learned: This involved a detailed report identifying the successes and failures of the implementation phase, providing crucial insights for future iterations or expansions.

Trial findings

The introduction of new bundles each month, based on learnings from previous months, showed a pattern of reduced private car use among subscribers compared to those who chose the pay-as-you-go (PAYG) option. Detailed analyses, such as that for the Fifty50 bundle, revealed that car usage significantly reduced (after subscription) and remained lower than PAYG users for the duration of the trial. The

GreenPass bundle showed a similar reduction in car usage post-subscription. The trial found a notable increased interest in public transport use via the GreenPass bundle.

The Fifty50 bundle was the most cost-effective, with subsidies ranging from $3.62 to $25.90 per month, and resulting in $CO2_e$ reductions of 55 to 65 kg per person per month. Saver25 and SuperSaver25 provided the highest environmental benefits overall, with $CO2_e$ reductions of up to 154 kg per person per month. The GreenPass bundle was the most expensive in terms of the financial subsidy provided but offered a lower $CO2_e$ reduction.

Overall, the trial provided strong evidence that the use of the subscription bundles moved travellers towards more sustainable transport options. There was a noted reduction in car use, especially among those who also subscribed to the Safer Journeys Program. However, the emission-busting challenge was unsuccessful, most likely due to the limited trial period cut short by Covid-19.

Trial conclusions and recommendations

The trial and subsequent analysis found that MaaS bundles, if designed appropriately, can be influential in shifting traveller behaviour towards more sustainable modes of transport. The trial presented a strong case for the potential of MaaS to significantly reduce car usage and thereby contribute to a decrease in emissions and traffic congestion. Overall, the trial emphasised the role of subscription-based travel bundles in shaping future sustainable urban mobility solutions. The right mix of incentives, coupled with effective communication and public awareness campaigns, could make a tangible difference in achieving sustainability goals in transportation.

That said, the trial revealed the significant commercial challenges facing a viable MaaS platform, which have generally relied on government subsidies. Moreover, the concept of using more than one mode of transport for a trip poses challenges for both providers and users although factors like urbanisation and digitalisation are driving the growth of intermodal trips. A primary challenge for MaaS is encouraging people to shift from owning and using private vehicles to accessing mobility services as needed. While MaaS can alleviate congestion, the appeal of private electric vehicles with lower running costs presents competition to the concept. The trial proponents concluded that true disruption in the mobility sector will occur when foundational principles are challenged. This might involve leveraging autonomous technologies, integrating with non-transport sectors like retail or real estate, and redefining the very concept of 'service' in MaaS to include non-transport benefits.

The trial also undertook qualitative interviews. The qualitative one-on-one interviews have suggested a number of factors influencing trial choices and to help inform key markets for future bundle design. The main factors were:

- Value for money of subscription plans;
- The availability of modal alternatives despite offering them in a bundle, unusual travel patterns i.e. less habitual and more variety seeking;
- The lack of awareness of the details of the subscription bundles because of the way information is provided, especially its clarity;
- The need for commitment emerged as a real constraint on participants' desire to subscribe, although a 'novelty' or 'curiosity' effect for the subscription plans was very apparent; and

- MaaS programs should consider how they might offer a distinctive level of service (separate from the attraction of the digital platform) that is not available to travellers outside of a subscription plan. An example might be a guaranteed door-to-door personal service twice a week, effective when individuals have a change in routine that can benefit from a bespoke transport service.

In summary, the trial indicated that there is potential in MaaS products to promote sustainable travel behaviour and reduce environmental impact. While the results from the trial are promising, it will be crucial to develop a sustainable business model that balances the costs and benefits while considering changing societal and environmental factors. The broader narrative underscores the complexities and challenges of integrating MaaS into the fabric of urban planning and societal behaviour, especially when external factors, like the Covid-19 pandemic, introduce unforeseen variables.

The trial produced a number of recommendations:

(i) MaaS design needs to reflect/match/seek to influence customer behaviour and drive a cultural shift from ownership to access. As such:

a. Ongoing information sharing and education are critical to drive a change in habits. However, any change will be gradual.

b. This requires any roll out to be evidence based and iterative.

c. More multimodal people are more likely to sign-up than less multimodal people.

d. Understanding of the impact of transport use on sustainability can drive behaviour change, however, changing car use habits are a challenge.

e. It is important to acknowledge that post Covid-19 there has been a significant shift in the effectiveness and acceptance of working from home and concern about social distancing on public transport for some people.

(ii) Any MaaS app needs to:

a. Be easy to explore (option for no sign-up costs and PAYG functionality.

b. Integrated (easier to use than Google Maps or single service provider apps).

c. Place public transport as the primary mode with door-to-door a focus.

(iii) In terms of user costs:

a. Integration of pricing across modes is vital for the platform to be effective, along with flexibility in subscriptions (especially over vacation periods or when working from home).

b. There has to be economic benefit for the user (i.e. less expensive than buying tickets elsewhere).

c. Subscriptions should cater to varying needs, including seasonal ones.

d. Subscription plans for broader groups (households, friends, employees, tourists) rather than just individuals should be available.

(iv) In terms of policy and governance:

a. To underpin its viability, MaaS should support societal goals, potentially with aligned public subsidies and/or road pricing reform. This may mean a significant post Covid-19 shift away from road infrastructure projects which have created 'car as norm' for some trip types and have not reduced congestion as intended.

b. In broader public policy terms, a shift towards the sharing economy, reducing car ownership should be encouraged.

c. Clear governance models are essential, ensuring trust and collaboration within the MaaS ecosystem.

NSW Regional Blueprint

Overview

The Institute of Transport and Logistics Studies (ITLS), based at the University of Sydney, led the Regional Town and Rural Hinterland (RTRH) MaaS Blueprint project from October 2021 to June 2023 (Nelson et al, 2023). The project was sponsored by iMOVE and Transport for NSW. The project's vision was to improve access to services, both local and more distant, within the context of encouraging fairness and equity, and contributing to overall environmental sustainability. This project was not a MaaS trial as such, however the Blueprint presents interesting information with regards to transport disadvantage and improving equity and access. It raises a number of questions in terms of regional transport gaps identified by the project, the 'Car Community Club' concept, and discussion around asset utilisation and how Mobility as a Feature (MaaF) could be suited to a regional context.

The Blueprint recommended a multi-service approach, including transport modes heretofore not present in the rural and regional landscape, and non-mobility services. The Blueprint recognised that private transport will play a relatively larger role in the configuration of rural and regional MaaS platform services than in an urban setting and proposed the concept of the Car Community Club (discussed below). A key focus of the Blueprint was to set out the critical role of governance and, relatedly, the central role of TfNSW in enabling and supporting the development of stakeholder roles and responsibilities. The Blueprint was designed to serve as a reference for transport authorities, transport service providers, and other stakeholders and aims to offer insights into potential transport solutions and implementation challenges specific to each local context. (Nelson et al, 2023).

In Australia and globally, MaaS platforms have been primarily considered in an urban context where typically there is a core local public transport offering and a wide variety of private transport providers. A MaaS platform service in a rural and regional setting is much less likely to have conventional public transport as its core and thus, more weight needs to be given to the role of the car as a potential shared or collective service and to consider how trip needs are likely to include travelling outside the rural and regional setting to locations where specialised services are provided (See Mulley et al., 2023).

The project's central hypothesis was that, in a rural and regional context, the inclusion of non-mobility services could improve the viability of MaaS services. Importantly, an effective rural and regional MaaS

service must include connectivity with the rural hinterland beyond regional towns and the regional public transport network.

Approach

The Blueprint comprised four strands of work.

1. A literature review that provided an up-to-date perspective on the key elements of MaaS in the context of regional towns and rural hinterlands, including barriers identified to date, through examination of recent "on the ground experience" with MaaS and MaaS-like schemes, primarily in a rural context but also including reference to urban areas.
2. Seventeen in-depth interviews conducted with service providers (transport and non-transport) in the three locations selected for detailed study (Dubbo, Nowra, and Coffs Harbour). These interviews yielded valuable insights into the perspectives and experiences of stakeholders who could be involved in MaaS services provision in these areas.
3. End-user group discussions with 45 participants, which included a 'pencil & paper' survey, conducted in the same three locations. This approach engaged directly with end users and captured their mobility barriers, feedback and suggestions, contributing to a deeper understanding of their mobility needs and expectations.
4. A NSW-wide online survey (916 respondents) targeting residents of the 16 regional cities to provide a broader perspective, allowing for the identification of preferences and needs related to mobility and non-mobility services in regional and rural areas.

Literature review findings

Nelson (2023) made a number of general observations on rural MaaS schemes drawn from the review of literature and evidence.

- Most schemes currently branded as MaaS are better classified as journey planners or "MaaS-lite," offering integrated information, booking, or payment rather than comprehensive mobility solutions. This is attributed to the nascent stage of rural MaaS development.
- Rural MaaS is distinct and should not be directly compared to its urban counterpart. Most rural MaaS schemes are short-lived pilots, especially in pioneering regions like Finland and Sweden. These pilots vary in approach, some aiming for a complete MaaS experience from the start, while others build the foundational elements gradually. The small user base of some schemes poses a challenge, but population density, a critical factor in urban MaaS, is less crucial in rural contexts.
- Rural MaaS initiatives are diverse, each tailored to specific user groups, making the transfer of policy lessons complex. There's also a prevalence of niche schemes targeting specific sectors like tourism. Trust and partnership are essential in developing MaaS, as exemplified by successful initiatives that involve comprehensive stakeholder engagement.

- Car-based modes are gaining prominence in rural MaaS, reflecting the limited role public transport plays in these areas. App integration is common even in small schemes, indicating that technological challenges are largely addressed, with the focus now shifting to organisational and business model development.

- There's minimal focus on school transport in rural MaaS offerings, and technical evaluations of existing schemes are limited. Proper evaluations are essential to identify transferable aspects for new locations. Rural MaaS's prospects for scalability appear limited but are integral to the Netherlands' pilot schemes.

- The Finnish national approach to MaaS, while unique, hasn't significantly impacted rural implementations, underscoring the need for viable business models in rural settings. Public-Private Partnership models are suggested as potentially suitable for rural areas with low transport volumes but long travel distances. Japan's regional MaaS archetypes offer insights into tailoring MaaS models to regional characteristics.

- The role of policy-related stakeholders is vital to create an enabling environment for Rural and Regional MaaS. It's important to recognise that the success of a MaaS solution is context-dependent and may not be replicated with equal effectiveness in different settings.

- The literature review underscored the importance of understanding the unique elements and barriers of MaaS in rural and regional contexts, drawing on experiences from various countries including Finland, the Netherlands, Sweden, the UK, the USA, and Japan.

System-wide engagement is vital to manage complexity

The Blueprint highlighted the critical role of governance in the delivery of rural and regional MaaS platform services in order to manage multiple stakeholders. Stakeholders include government agencies, transport service providers, health and aged care organisations, community members, First Nations groups, digital platform providers, and business-related sectors. These stakeholders play various roles in supporting policy, funding, regulatory frameworks, data sharing, identifying transport needs, ensuring accessibility and affordability, cultural sensitivity, technology provision, and attracting investment.

The Blueprint recommended a governance framework that should prioritise trust and partnership building between public and private partners and focus on institutional and behavioural/contextual settings rather than just technology (i.e. the dynamics of governance not just the mechanics). It should facilitate exploration of new opportunities and utilise underused assets in the mobility market. The stakeholders within the governance framework can assess the suitability of bundling mobility and non-mobility services, considering the relative relevance in their specific context.

Rural and regional MaaS is different

The Blueprint highlighted the unique features of rural and regional MaaS relative to its urban counterpart as follows:

- There are differences between the requirements for rural/regional MaaS and urban MaaS. In regional areas, there are limited transport options, vast distances, lower population density, a higher dependence on private cars, and often greater socio-economic uncertainty.

- Compared to urban areas, rural areas often suffer from a digital divide, with varying levels of access to digital infrastructure and technology, and a population demographic that may include a higher proportion of older individuals with limited digital literacy.
- Public transport is less likely to be the core service offering in rural areas, so the role of the car as a shared collective vehicle becomes more important.
- Addressing transport disadvantage is a priority, and including non-mobility services which can support the sustainability of rural and regional MaaS.
- Connectivity beyond regional towns and the inclusion of longer-distance public transport services are critical in a rural context.

As such, rural and regional MaaS frameworks should try to encompass existing transport modes while identifying gaps in provision and encouraging new and innovative mobility options. This may include introducing ride-share services, on-demand public transport, shared bikes, e-bikes, and fostering the use of underutilised car capacity through initiatives like the Car Community Club (see below). Innovative models such as Mobility as a Feature (MaaF), which involve private non-mobility partners and cross-subsidisation, can also enhance mobility options in rural areas.

The Blueprint developed a proposal for a Car Community Club (Triple 'C') which operates as a membership-based club for drivers and residents. It is not a car-sharing service but rather a platform that matches private car trips between drivers and potential passengers. Drivers list their trips, and passengers can request trips to specific destinations. When a trip is matched, the passenger voluntarily donates to the Triple 'C'. A portion of the donation remains with the Club to support safety checking and matching processes, while the rest is given to the driver. The allocation of the donation can be decided on a case-by-case basis, with guidance on fair allocations. The Triple 'C' can also coordinate with parcel delivery and accommodation services to offer discounted overnight stays if needed. The aim is for the Triple 'C' to become self-sustaining through donations, but initial financial support and government assistance may be required for app development and governance.[15]

Mobility as a Feature (MaaF) is a concept which may be more relevant and applicable within rural and regional settings. A rural and regional MaaF which goes beyond the multi-modal approach and incorporates a multi-service approach may produce benefits for all stakeholders. In addition to providing various mobility options, a MaaF includes non-mobility services such as parcel deliveries, library services, food and medicine distribution, and media streaming. This broader range of services not only meets a wider range of user needs but also allows for cross-subsidisation, which can enhance the financial sustainability of both the mobility and non-mobility offerings. MaaF is designed to be financially sustainable and driven by organisations that have a large customer base but no direct interest in transport supply ownership. For example, an insurance company could offer reduced car insurance premiums to car owners in exchange for reduced car use and increased travel using more sustainable modes of transport.[16]

[15] Not all stakeholders supported the Triple C concept. Some who reviewed the Blueprint regarded the idea as untested and argued that it would require substantial work before being considered for real world trials.

[16] For a full discussion of the MaaF concept, see Hensher, D.A. and Heitnan, S. (2023).

Benefits to stakeholders

The Blueprint assessed the benefits of rural and regional MaaS from the perspectives of various stakeholders, including transport and non-transport providers, users, government, and the private sector. The time horizons and sustainability implications should also be considered.

From the user perspective, rural and regional MaaS offers benefits such as improved access to medical services, including those at a distance, leading to greater independent living. It can also enhance employment prospects, access to education and training opportunities, and promote social inclusion, thereby improving the standard of living and mental well-being. Rural MaaS can also alleviate the burden on carers by reducing the need for them to provide transportation or bear the costs of accessing services. Overall, rural and regional MaaS has the potential to provide rural residents with improved freedom, empowerment, capability, and security.

From the provider perspective, rural and regional MaaS offers benefits such as the opportunity to utilise underused assets, such as Community Transport vehicles that are not used on weekends. Local design and the implementation of integrated services can foster beneficial stakeholder partnerships. The existing modal landscape suggests that different modes can collectively address different needs, provided mode-specific issues are addressed. Implementing a new mobility framework can optimize the potential of an integrated system to meet community needs, improve transport disadvantage, and enhance sustainability in mobility use.

For the private sector, rural and regional MaaS offers benefits by creating opportunities for new businesses through better-connected transport services and integration with non-transport services within a larger network. Facilitating easier access to regional towns, both from the hinterland and further afield, benefits the regional economy and stimulates investment by local businesses.

From the government perspective, rural and regional MaaS offers benefits such as improving accessibility for disadvantaged populations and promoting mobility justice and fairness for all. It enables a less siloed approach to funding transport services, minimising duplication and increasing efficiency. With a better understanding of community needs, governments at the local and state levels can make informed decisions about funding distribution. The development of public-private partnerships becomes essential for providing better-integrated transport services.

Roadmap to implementation

The Blueprint set out a ten-step roadmap to implement MaaS in regional NSW:

Source: Nelson et al (2023).

Conclusions

The Nelson et al (2023) study has made an important contribution to the development of MaaS in a non-urban context. In particular, the Blueprint highlights:

- The potential for improved accessibility, especially for disadvantaged groups (to improve social equity) and an enhanced user experience.
- The critical role of multi-stakeholder engagement and the importance of including a wide range of stakeholders (often, but not always, with competing interests) in a governance framework.
- The viability of a MaaF rather than a MaaS solution in regional and rural areas (in response to a lack of public transport and a need to provide services across a broader geography). This approach also recognises the cultural characteristics of regional and rural communities such as higher levels of volunteering and a willingness to maintain social cohesion. It also offers an approach to economic diversification in regional and rural areas via investment by local businesses.
- The attractiveness to governments in terms of potential cost savings due to a reduction in duplication of services and improved equity for often more disadvantaged communities where this is identified as an objective of MaaS. However, in many cases the MaaS/MaaF will require government subsidies/cross-subsidies in the short and longer term.

- The need to recognise the potential of innovative and tailored solutions, including solutions which are car based, in the MaaS offering.
- The need to communicate and market MaaS particularly as the 'less visible' modes may be unfamiliar to potential customers.

The ODIN Pass trial in SEQ

Trial design and objectives

The ODIN Pass trial (2021-2023) was developed by the University of Queensland (UQ) and its commercial partners, and was financially supported by iMOVE and TMR. The ODIN Pass is a digital platform that provides travellers with single price access to multiple travel services by bundling public and private transport options. In the trial, participants (mostly UQ students and staff) purchased a time-limited MaaS bundle (e.g. monthly), which varies in price depending on the specific inclusions and timeframe. The bundles include options such as unlimited public transport and unlimited electric bike/scooter share, as well as providing discounts on taxi/ride-sharing trips and car-sharing services.[17]

This project consisted of four primary stages:

1. Stage 1: Collection of pre-trial data from UQ staff and students.
2. Stage 2: Establishment of the MaaS trial framework for the ODIN PASS scheme.
3. Stage 3: Deployment of the MaaS trial.
4. Stage 4: Analysis of the results of the MaaS trial.

The trial began in 2021 with a pre-trial survey of UQ students and staff to determine the most feasible service/price bundles to offer based on a stated preference survey design to determine consumers' WTP for service bundles. The survey asked respondents about their preferences in relation to:

- Bundle features (e.g. transport modes, geographic range and pricing);
- MaaS features (e.g. mobility partners); and
- ODIN PASS app features (e.g. account creation and data management).

The trial was subsequently extended to include delegates to the ITS Australia Summit, held in Brisbane in August 2022. Through a collaboration between Translink and Neuron Mobility (a micro-mobility service provider), ODIN PASS was able to design and offer the 'Summit Mobility' bundle — $20 for 7 days — to delegates. Features included:

- Unlimited public transport on bus, train, ferry and tram across SEQ;
- Unlimited Neuron e-scooter and e-bike trips for up to 90 minutes per day; and

[17] See https://odinpass.com.au

- Access to pay-as-you-go mobility services from Beam, 13cbs and GoGet.

Lessons

The trial was successful both in technical terms and 'lessons learned'. In the view of the Odin Pass Trial proponents, the lessons included:

(i) Trial proponents and/or start-ups will need to fully understand the requirements and needs of users ex ante — don't assume it is what MaaS proponents say. Avoid buying white-label (i.e. off-the-shelf) app operations, unless there are ironclad guarantees that the operator has significant control over the app functionality, and data integrity. In this regard, ensure consistent iOS and Android user experiences, or avoid native apps completely via the use of a mobile web app.

(ii) Develop cross-governmental (i.e. all three tiers of government as well as the relevant departments and other agencies) support for MaaS which provides market stability as far as possible. As part of this, develop strong partnerships and trust between stakeholders.

(iii) Support data sharing via workable regulation.

(iv) Engage with Transport Service Providers (TSPs) and regulators to ensure sufficient data sharing in order to provide a workable MaaS ecosystem. Further, develop a rigorous process for checking data integrity.

(v) Ensure there is sufficient budget for legal costs because these costs can be unexpected and large.

(vi) If possible, secure (modest) discounted prices to maximise chances of consumers switching to the MaaS platform (see quote from the UQ MaaS Trial report below).

> "The primary mode included in the platform is public transport via Translink. Translink is billing the trial for the full cost of public transport, at retail costs. This provides no margin for the operator, yet the operator is taking all the risk in offering an unlimited pass to encourage greater use of public transport. While it is recognised that public transport is already heavily subsidised, if MaaS is to achieve its full ambition of increasing the utilisation of public transport there will need to be a sustainable business model for operators, which will be reliant on alternative approaches to Translink pricing." (UQ MaaS Trial report, 30 October 2021, p.16).

Case studies: MaaS developments overseas

This chapter provides a high-level summary of selected overseas MaaS developments. Its purpose is to draw lessons from the overseas experience in the Australian context. The examples provide a flavour of recent developments and are by no means intended to be comprehensive.

Examples of success overseas

MaaS has seen varying degrees of success across the globe. Key examples of successful implementations include cities like Helsinki (Finland), where the concept of MaaS was born, and Gothenburg and Stockholm (Sweden), where large-scale trials were carried out. The success of these overseas MaaS trials and implementations can be measured through several metrics. These include user satisfaction, increased use of public and shared transportation modes, reduction in private car use, decrease in traffic congestion, improved accessibility, and environmental impact. However, on other metrics such as financial sustainability and the level of integration of some transport services, these European deployments have been less successful For example Whim struggled to generate an adequate return on investment and is now terminating its operations in several countries.

Mitropoulos et al (2023) describes the origins of MaaS as follows:

> Despite the fact that several MaaS solutions have been developed lately at the global level, the MaaS concept has its roots in the Nordic nations. It is claimed that Heikkilä coined the term in 2014; her thesis resulted in a call for pilot projects from the Finnish Innovation Agency and led to the founding of the first MaaS company in 2015, named MaaS Global. They developed the Whim app that operated in Finland, Austria, Belgium, Japan, and the UK. Moreover, around the same time in Sweden, a MaaS trial known as Go:Smart (later renamed UbiGo) was financed by the Swedish Innovation Agency to develop, test, and evaluate ways of offering a mobility solution for sustainable traveling in the city of Gothenburg. UbiGo was launched in Stockholm in 2019 but ceased operation in early 2021. Although several pilots have been demonstrated and evaluated, only a small number of them resulted in a product in the market. (Mitropoulos et al, 2023).

Overseas, MaaS and 'MaaS-light' platforms are currently operating in a number of countries. For example, as at June 2023:

- Whim is currently operating in Italy and Turkey
- WienMobil operates in Vienna, Austria.
- GO! operates in the San Francisco Bay Area.
- MOIA (owned by Volkswagon Group) is available in Berlin and Hamburg and focuses on ride-sharing.
- FlexDanark, is available in Denmark and focuses on ride-sharing to increase vehicle occupancy.

- Mobit is in Antwerp, Belgium and offers shared bike services.

Europe

Europe has been at the forefront of MaaS trials, with several significant projects taking place in cities like Helsinki, Stockholm, and Berlin. European cities benefit from critical mass and density in terms of population and transport infrastructure, relatively high incomes and generally strong support for environmental sustainability and equity policy goals.

Berlin: Berlin trialled MaaS through the Jelbi app, integrating public transport, car sharing, e-scooters, taxis, and bike sharing into one app, aiming to make Berlin's public transport more user-friendly and reduce private car usage.

Helsinki: In Helsinki, the Whim app was launched in 2016 as the world's first MaaS solution. The city's transport authorities worked together with private operators to bundle all forms of transport – buses, trams, taxis, bikes, and rental cars – into one app. This made it easy for residents to plan, book, and pay for multiple types of transport from a single platform.

Stockholm: The UbiGo app in Stockholm operates on a subscription model, where households can subscribe to various packages of public transport, car sharing, rental car service, taxi, and even bicycle sharing. The trial reported high satisfaction among users and significant decrease in the use of privately-owned cars.

Asia

Japan: In Japan, the government is actively promoting the MaaS concept through its national MaaS promotion council. In 2019, Toyota launched a MaaS pilot in Tokyo, integrating public transportation with its taxi-hailing app.

Singapore: In Singapore, the Land Transport Authority has launched a comprehensive MaaS app called SimplyGo, which allows users to pay for all public transport through their contactless bank cards.

North America

Los Angeles: The MaaS trial is notable with the launch of the TAPforce app, which provides integrated ticketing for different transportation modes, including bike share, e-scooters, and buses.

Toronto: Toronto has tested the concept of MaaS through a collaboration between Metrolinx and the Transit App. The Transit App integrates information for all modes of transportation, offering route planning and real-time information.

Snapshot of overseas MaaS activities

Mitropoulos et al (2023) provides a summary of MaaS and MaaS-like trials and commercial operations (Table 0-1).

TABLE 0-1 SNAPSHOT OF CURRENT MAAS TRIALS AND COMMERCIAL SERVICES (JUNE 2023)

Application Name	Transport Modes	Demo Site
Beeline	Bus services	Singapore
BIP for MaaS	Public transport, bike sharing, traditional, free floating and electric car sharing, and carpooling	Torino, Italy (EU)

Bridj	On-demand commuter shuttle service	Boston, Kansas City, and Washington DC
Communauto/Bixi	Bike sharing and car sharing	Quebec, Canada (US)
EMMA	Public transport system, Bike sharing system, car and bike parking services, car sharing,	Montpellier, France (EU)
Get me there	Bus, tram, metro, taxi, car-sharing, rail, coaches, electric vehicle charging infrastructure, and parking operators	Greater Manchester, North-West England
Hannovermobil 2.0	Public transport, car sharing, and taxi	Hanover Region, Germany (EU)
Helsinki Model (Whim app) (recently wound down April 2024)	Public transport, taxis, city bikes, car rental, car sharing, e-scooters, and shared bikes + on-demand transport	Helsinki and Turku, Finland (EU)
MaaS-London App	Car clubs (car sharing services), ride sharing, bike sharing, taxi and all types of public transport (London underground, overground, bus, tramlink, DLR, river bus, and national rail)	London (UK)
Mobility Shop	Public transport, bike sharing, car sharing, car rental, taxi, train	Helsinki, Finland (EU)
Moovel	Public transport, car sharing, car rental, national rail, bike sharing, and taxis	Germany (EU), also testing in Boston, Portland, and Helsinki
Qixxit	Car sharing, ride sharing, and bike sharing	Germany (EU)
SHIFT	Shuttle buses, bike sharing, car rental, car sharing, and valet service	Las Vegas (US)
SMILE App	Public transport, rail, car sharing, bike sharing, car rental, taxi	Vienna, Austria (EU)

TransitApp	Public transport, bike sharing, car sharing, taxi, ride-hailing	USA, UK, Canada, Europe, Australia
Ubigo	Public transport, car sharing, car rentals, bike sharing, taxi service, car-pool, and bike-pool	Gothenburg and Västra Region, Sweden (EU)
URBI mobility	Regional and city trains, subway, trams, buses, free-floating and stationary vehicle-sharing, scooter-sharing, bike-sharing, taxis, and Uber	Berlin Brandenburg metropolitan and regional area, Germany (EU)
WienMobil Lab	Public transport, bike sharing, car sharing, taxi, parking garages	Vienna, Austria (EU)

Source: Mitropoulos et al (2023).

Implications for the Australian context

MaaS trials have been conducted in numerous cities around the world to understand the potential and challenges for the integrated transport platform. A number of lessons can be drawn from the overseas experience, which are relevant to the Australian MaaS challenge:

- **Understanding local travel behaviours and mobility barriers** in urban, in inner suburban areas, at the boundaries of cities and in regional towns is crucial. Geography is important as to whether MaaS or MaaF will be more successful in some locations rather than others.

- **The integration of different modes of transport services** into one digital platform, including robust digital and transport infrastructure.

- **User-centric design**, designed around the needs and preferences of customers, with an easy to understand system which meets the diverse mobility needs of users.

- **Heavy reliance on smartphone apps**, providing users with information about different transport options, route planning, booking, and payment features.

- **Seamless payment integration** across different modes of transport is key to user adoption. Workable data sharing protocols and standardisation are required to ensure real-time updates, efficient route planning, and better service delivery.

- **Innovative pricing models** which are fine-tuned over time including subscription or pay-as-you-go models.

- **A strong partnership between public and private transportation providers** is crucial in order to encourage modal shift from private cars to shared and public transportation, with the goal of reducing traffic congestion and environmental impact. The commercial and regulatory challenges would be, arguably, impossible to overcome without close cooperation between the public and private sectors.

- **Identifying sustainable and equitable business models remains a challenge,** especially when determining pricing structures that appeal to users while ensuring profitability. However, with some government support for start-ups and a recognition of the broader environmental and equity benefits of MaaS, it is possible that MaaS could be commercially viable in some parts of Australia.

- **Strong support from city authorities or national governments,** highlighting the growing recognition of MaaS as a potential solution to urban mobility challenges.

- **Policy intervention from governments** helps to provide a conducive regulatory environment and encouraging the use of MaaS through policies and initiatives.

- **Public acceptance** which leads to behavioural change.

In summary, while MaaS holds significant promise for transforming urban mobility, its successful implementation requires: careful planning, collaboration, and continuous adaptation based on user feedback and evolving transportation landscapes. Lessons from international practice highlight: the need for improved digital infrastructure, collaboration among stakeholders, and tailoring MaaS schemes to local contexts.

There is no one-size-fits-all approach, and strategies must consider the specific technical, commercial, legal and regulatory barriers and opportunities in each location.

The future for MaaS in Australia

Overview

In several cities in Europe, North America and East Asia MaaS and MaaS-like platforms have proven to be technically feasible and, in some cases, commercially viable in the sense that the platforms remain in operation without ongoing taxpayer support. That said, all had significant limitations in terms of scalability and access. Bundling passenger transport and non-transport services into a single offer benefits users in terms of cost savings and the increased convenience of 'end-to-end mobility' relative to separately sourced transport service offers. The core value proposition of MaaS has been to increase customer benefits by conveniently providing additional services and increased choice on a single digital platform.

From the transport provider's perspective, there is some evidence that MaaS platforms can improve network efficiency by optimising supply and demand (via bundle and PAYG price adjustments), especially during peak hours when certain modes or particular routes are underutilised. Consequently, MaaS platforms can, in theory, reduce traffic congestion and, consequently, GHG emissions.

That said, whether and how MaaS becomes a widely used transport service in Australia's major cities (or overseas) is uncertain. Some transport experts see further uptake of the MaaS model beyond its current use in several major global cities as problematic citing limited incremental consumer benefits from the service, while others remain confident of its inherent technical advantages, consumer appeal, social benefits and commercial viability.

Given the need to tailor many aspects of MaaS to specific contexts, if the scope and scale of MaaS is to increase, experts and policymakers will need to identify the necessary conditions to move MaaS out of a niche offering in several large global cities to one that is scalable across a broader set of different urban and regional environments. This challenge is largely (but not exclusively) focussed on the supply side, that is in offering and delivering the services that users want to consume based on an understanding of potential user behaviours and needs. The essential tasks will be in developing an access platform that houses all the digital apps of the various MaaS providers and allows for data sharing, a governance model that appeals to all participating parties, and the sharing of the benefits (e.g., revenue), costs, and associated risks, amongst participating parties (Smith and Hensher, 2020).

A complete assessment of MaaS should consider its usefulness as a public policy tool in addition to its technical and commercial viability. If MaaS can contribute towards public policy goals, then some government financial and regulatory backing would be justified.

In this regard, critical to the future of MaaS will be the requirement to:

- Clearly define and align the public policy goals related to MaaS and their social value, including:
    - Environmental sustainability goals; and
    - Mobility access goals

- Understand exactly which aspects of MaaS platform services provide benefits to customers and society; and
- Design and implement a workable commercial framework, which requires a common (or widely used) platform/s and addressing many legal and regulatory issues such as customer data privacy and other data-related issues.

Characteristics of a future MaaS

The future of MaaS in Australia will be shaped by broader technological, economic and social trends, including cities and regional policies, our national and state carbon reduction goals, trend towards working and studying from home, the rise of the shared economy and the gig economy, artificial intelligence (AI) and digitalisation. Technological advancements will continue to play a central role in the evolution of MaaS. The application of AI and big data can enhance route optimisation, predictive analytics, personalised services, and demand-responsive transportation services. These technologies have the potential to not only improve the user experience but also increase the efficiency and effectiveness of MaaS platforms. If, as forecast, Australian cities grow in size and density, and digital platform services become an essential part of our lives, the demand for efficient, affordable, and convenient end-to-end mobility services could be expected to correspondingly rise.

Similar to overseas developments, MaaS in Australia is likely to move beyond providing only transport services and offer a range of non-passenger transport services like grocery and parcel delivery and leisure activities. The commercial goal is to attract a broader base of users by designing MaaS to be more user-centric and environmentally sustainable, which most customers are likely to value. In other words, the future may entail moving from a 'multi-modal' framework to a 'multi-service' framework (i.e. MaaS to MaaF).

It is inevitable that a single platform, or a limited number of platforms, will dominate the Australian MaaS market given the consumer and producer benefits of operating on a single platform. The experience of digital platform technologies has been to consolidate rather than fragment, which provides for a larger and deeper markets that in turn creates value for customers and producers.

Hensher (2020) sees a future MaaS moving beyond the original conception of end-to-end mobility:

> We also believe that MaaS needs to be seen as more than a multimodal offering, but as a multiservice offering. What we mean by this is that some of the services are not only the passenger mode discount, but discounts on non-transport services, for example, retail purchases, as well as having goods delivered to the subscriber, and especially where WFH becomes more popular, or MaaS points that can be redeemed for goods or gift cards. We finally can see the word 'service' being given a much broader and meaningful multi-sectoral definition, which may be the basis of a business case that can morph into a commercial proposition. (Hensher 2020, p.4).

A proposed tendering authority to deliver Maas benefits

Operationalising MaaS is a complex undertaking.[18] This is because many stakeholders with many legacy systems need to come together to present a single offer to consumers. Hensher and Wong (2023) propose a *tendering authority framework* that would be responsible for a common access MaaS platform into which competitive tendered MaaS consortium bids are assessed with multiple 'winners' selected to ensure coverage of all multimodal and multi-service products across the successful bid. Such an approach serves to give users bundle and PAYG choices and ensure a competitive MaaS market.

The tendering authority would be responsible for defining a suite of societal linked key performance indicators (KPIs) that are connected to financial and non-financial rewards available to each MaaS consortium and their subscribers, when changes in travel behaviour align with the societal KPIs. Different jurisdictions might select and weight different societal KPIs.

The common framework is a digital app through which users access different MaaS products. This framework allows users to seamlessly switch between different MaaS providers, ensures standard payment and reward mechanisms, and facilitates data collection for the tendering authority. Operationalising this framework would require establishing rules around tendering to be a part of a commonly used MaaS platform. Here, the government would play a role, given its interest in utilising MaaS to achieve its public policy objectives. In particular, Hensher and Wong (2023) recommend that a State Government may introduce Societal KPIs as an essential aspect of the framework.

The technical architecture of this framework provides integration, convenience, data capture, protection of commercially sensitive data, scalability, and portability. It also ensures that rewards are linked to Societal KPIs, making it attractive for both users and service providers.

Specifically:

- Data Sharing: The framework handles the controversial topic of data sharing by requiring MaaS consortia to share only aggregated passenger data with the tendering agency. Detailed data sharing isn't necessary, avoiding many privacy concerns.
- Payments, Incentives, and Rewards: Consortia would receive public transport subsidies from the government and could cross-subsidise various services. Financial rewards associated with societal KPIs would require consortia to provide aggregate public transport usage data to the tendering authority.

It is up to the MaaS bidder, who will most likely be structured as a broker or aggregator for a team of providers (i.e. a consortium), to negotiate with transport service suppliers and indeed non-transport service suppliers, to design the services and incentives they include in their MaaS bid offer, and to decide if they will stay with PAYG and/or add in subscription bundles. If staying with PAYG, there will need to be a financial mechanism proposed to support any offer of discounts and/or rewards on specific modal

[18] This section follows Hensher and Wong (2023).

trips (in contrast to support from a subscription fee for a bundle), obtained from the transport suppliers or other services under a multi-service model.

The financial model can incorporate cross-subsidisation between services and will be at the discretion of each MaaS bidder. The winning consortium would also gain additional financial and non-financial (e.g. points) rewards from the tendering agency (e.g. TfNSW) if they satisfy specific KPIs. These latter KPIs should have a societal impact focus aligned with sustainability objectives (including social licence goals) to reward the greater use of modes that reduce emissions and congestion and deliver health and/or other agreed benefits.

The connection to societal level KPIs defines the important role of the public sector, or a private organisation interested in promoting desirable societal outcomes that align well with their social licence. To monitor success in receiving KPI rewards, we need to find a way of tracking car kms. in particular. One possibility is to ensure that all subscribers to any MaaS product are able to provide car kilometres, through the same digital app associated with the MaaS product they are using, together with any other relevant mobility activity that is a candidate to achieving such KPI rewards.

Importantly, subscribers can use one or more MaaS products at a time. If they choose to use two MaaS products because, for example, one has bikes and the other has car share, the data capture necessary to provide incentive payment eligibility through the societal KPI scheme will be assessed at the common framework level by a user's unique identification code, which they would receive when registering with the common framework. (Hensher and Wong, 2023).

Conclusion

MaaS platform services potentially have a future in Australia in certain contexts, taking into account the existing known success factors based on Australian and overseas experience. The big trends in technology, living standards, work habits, and customer expectations will be generally supportive of MaaS platform expansion.

With the right combination of technology, policy, and business model innovations, MaaS has the potential to transform urban transportation, making it more convenient, efficient, and sustainable. However, the realisation of this vision requires concerted effort from all stakeholders, including governments, transport service providers, technology companies, and users.

MaaS can also play a pivotal role in promoting sustainability in urban transportation. By reducing reliance on private cars, MaaS can help reduce traffic congestion, lower GHG emissions, and promote the use of greener modes of transport such as biking and electric vehicles. This aligns with global efforts to combat climate change and achieve sustainable urban development.

The Sydney MaaS trial summed up the components necessary for success as follows:

> If we were to refer to components of the MaaS ecosystem that are critical to its success, then they must be the identification of the nature and magnitude of the benefits to potential subscribers, which is central to the design of subscription bundles that have enough choices both with and between offered bundles to cover the attractive modal and multi-services, and that the digital platform is sufficiently rich to be able to respond to changes in the needs of growing MaaS subscription. (Hensher, D., Ho, C., Reck, D., Smith, G. (2020).

Mitropoulos et al (2023) reached a broadly similar conclusion to Hensher et al (2020), as follows:

> The delivery of innovative services like the MaaS, requires extensions in current activity-based modelling, considering the dynamic context of modern lifestyle, social influence, ICT, responses to travel recommendation systems, attitudes, subjective considerations, and the increasing degree of uncertainty. Thus, a critical reflection on how to expand current activity-based models and their underlying theories and choice models is needed to better capture the comprehensive nature of the travel behaviour and decision-making process related to MaaS. The novelty and fuzzy nature of MaaS make it a challenge to ascertain MaaS, to explore its implications, and how to address them. (Mitropoulos 2023, p.515).

To establish a successful, sustainable, and reliable MaaS (or MaaF) ecosystem, it's crucial to consider various enabling frameworks. Embracing or endorsing any particular framework in Australia can have wide-ranging consequences for all participants in the ecosystem. Therefore, it's essential to carefully understand and weigh the diverse objectives of ecosystem participants to arrive at the most favourable solution and avoid an unstable model.

A new project in 2023, sponsored by iMOVE and led by ITLS and Queensland's TMR, is dedicated to exploring the ideal MaaS framework that promotes sustainability and benefits both users and service providers.[19] This project recognises the multitude of actors within the ecosystem, their unique value-adding roles, and potential obstacles to adopting a sustainable MaaS framework. The project's goal is to develop and evaluate a proposed framework involving a tendering authority responsible for a common digital access platform.

Considering the numerous technical, regulatory and policy advancements in Australia and overseas, alongside increasing public acceptance, MaaS (and MaaF) holds the potential to positively transform our transportation systems. This paves the way for a future where mobility is more seamless, accessible, and sustainable.

[19] A framework of support to scale in MaaS. See here: https://imoveaustralia.com/project/framework-of-support-to-scale-in-mobility-as-a-service/

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Appendix A Economic theory of bundling

A1 Overview

Bundling is a common marketing strategy where two or more products or services are sold together, generally at a discounted price, compared to purchasing them separately. A producer (or reseller) will choose to aggregate a number of goods and services into a uniquely priced bundle if the benefits in terms of higher revenues from increased sales exceed the costs of bundling. A consumer will opt to buy a bundle of products (like a football game and a return train ticket to the game) if they see value in doing so relative to the alternative option of purchasing the products separately or only purchasing one of the products.

In economic theory, bundling can be socially beneficial if it results in increased consumer welfare, more efficient resource allocation, or greater competition. Several conditions need to be met in order for bundling to improve overall welfare.

- Economies of Scale and Scope: When a firm can produce or distribute bundled products more efficiently and at lower costs, consumers can benefit from reduced prices. This is often the case when there are economies of scale or scope in production or distribution.
- Improved Product Accessibility: Bundling may make products more accessible to consumers who may not be able or willing to purchase them separately. For example, streaming services (like Netflix) provide access to various digital channels at a lower cost compared to purchasing each channel individually.
- Price Discrimination: Bundling can allow firms to engage in price discrimination by offering different bundles at varying price points. This can benefit consumers with different preferences and willingness to pay, as they can choose the bundle that best suits their needs and budget.[20]
- Increased Product Variety: Bundling can incentivise firms to offer a greater variety of products, as they can leverage the popularity of one product to boost sales of less popular products. This can result in a wider range of choices for consumers.

[20] Price discrimination is a strategy used by sellers where different prices are charged for the same product or service to different consumers or groups of consumers, based on their willingness to pay, rather than any differences in the cost of production. Price discrimination is possible when a firm has some degree of market power and can segment its market to prevent resale among different consumer groups (i.e. arbitrage). Price discrimination can take several forms. First-degree price discrimination is when a seller charges each consumer the maximum price they are willing to pay for each unit of a product or service. Second-degree price discrimination is when a seller charges different prices based on the quantity purchased or the version of the product or service. Examples include volume discounts, tiered pricing plans, or different editions of a product (e.g., standard, deluxe, or premium). Third-degree price discrimination is when a seller charges different prices to different groups of consumers, based on observable characteristics such as age, location, or membership in a specific group. Examples include student or senior discounts, regional pricing, or special offers for loyalty program members.

- Risk Reduction: Bundling can help reduce risks for consumers by providing complementary products together. For example, bundling a smartphone with insurance can protect consumers from unexpected repair costs.
- Increased Competition: In some cases, bundling can increase competition by encouraging firms to differentiate their product offerings through unique bundles. This can lead to greater product variety and potentially lower prices for consumers.

The economics literature related to bundling is extensive. Stigler (1963) showed how bundling could increase sellers' profits under certain conditions related to how consumer's value the products being bundled. Adams and Yellen (1976) showed that bundling allowed for price discrimination, which can be socially beneficial in certain circumstances, and increased profitability. Schmalensee (1984) showed that bundling typically reduces the diversity of the population of consumers (in terms of their valuations of the bundle), making consumer valuations more predictable. This is important because if the marginal cost of the bundle is higher than the (unknown beforehand) mean consumer valuation, bundling will decrease profits because it decreases the fraction of buyers with valuations in excess of the total marginal cost of the bundle (that are required to achieve profitability). Schmalensee (1984) showed that, in general, the threshold at which bundling becomes less profitable than unbundled sales will depend on the distribution of valuations for the individual. Salinger (1995) found that bundling tends to be profitable when consumer valuations are high relative to marginal costs. McAdams (1997) highlighted the complexity of optimal bundling strategies with more than two products or services, requiring the seller to determine numerous prices and quantities that grows exponentially as the size of the bundle increases.

In the digital economy, a strategy of selling a bundle of many distinct information goods for a single price can often yields higher profits and greater efficiency than selling the same goods separately. Bakos and Brynjofsson (1999) postulated that bundling strategies take advantage of the law of large numbers to average out unusually high and low valuations, and can therefore result in a demand curve that is more elastic near the mean valuation of the population and more inelastic away from the mean. As a result of this predictive value of bundling, profits and sales can be increased. The authors developed a theoretical model to demonstrate that while the profitability and efficiency benefits of bundling are easiest to quantify when the consumer valuations are identically distributed and not closely correlated for different products, a bundling strategy can be profitable in a variety of situations including the bundling of complements and substitutes and bundling in the presence of budget constraints. The authors noted that historically it had been considered unprofitable and inefficient to bundle together large numbers of unrelated goods. However, their analysis suggested that the increasing availability of digital information goods should increase the significance of pricing strategies that leverage the predictive power of large-scale bundling.

The bundling literature typically makes a distinction between 'pure' and 'mixed' bundling. A pure bundle makes the purchase of B conditional on the purchase of A. In a mixed bundle, the purchase of A confers an option to purchase B. In relation to MaaS, the business model reflects mixed bundling — people purchasing the primary service A (the "tying good") may, but are not obliged to, purchase the ancillary service B (the "tied" good). For example, a commuter purchases a bundle because they plan to use the train service regularly, but want the options to use the other bundled services (like ride-sharing) which may be useful on particular occasions.

As an example, if a MaaS platform offered tickets to a football match as a part of its bundle, the impacts might include:

- Some saving in transactions costs, though possibly very small for those who go to the venue regularly;
- The ability to contract for improved collective transport options (e.g. better matching capacity with demand, arranging for buses that collect/deposit people at convenient spots, facilitating disabled transport);
- A reduction in congestion at or near the venue, providing a time saving to those who come by car;
- A possible reduction in the risk of accidents, if some people who would drink alcohol at the event are diverted into collective transport; and
- A possible improvement in the ability to price discriminate, e.g. if people who opt for collective transport are lower-income than those who use their own vehicle (as signalled by the willingness of the former group to incur a higher time cost in getting to and from the venue).

Of these impacts, the first four are productive efficiency gains, while the fifth is an allocative efficiency gain. Obviously, these gains need to be offset against costs incurred in developing and implementing the bundled offer. There are also some complexities in calculating these impacts, as there may be second round effects.

With respect to possible changes in modal shares, a shift of attendees from private to collective transport reduces the full cost of transport (i.e. the sum of the monetary and non-monetary costs) for those who continue to use private transport — for example, access roads to the venue will be less congested. As the full cost of coming by car falls, there will be some induced (i.e. latent) demand. Whether the Downs-Thomson paradox will come into play (so that congestion returns to its previous level) is an obvious question, but even putting that aside, the final effect will be less than the first-round impact and will depend on how take-up evolves.[21] (If everyone expects everyone else to choose public transport, and so decides to drive, there will be no impact on congestion: i.e. the outcome depends on the interplay of Nash-type conjectures). One possibility which addresses these issues but raises problems of its own is for the event organiser to offset the first-round reduction in the full cost of car transport by increasing (e.g. parking charges at the venue).

With respect to safety and accident risks, again offsetting behaviour should be considered. For example, if people who have shifted to collective transport believe that reduces their risk of being in an accident, they may drink more during the event, causing other costs (e.g. a greater risk of brawls).

[21] The Downs-Thompson paradox is a phenomenon in transportation economics that states that improvements to public transportation systems can lead to a proportional increase in road traffic congestion. The paradox can be explained by considering the competition between public transportation and private car usage. When public transportation is improved, some drivers may switch to public transport, freeing up road space and temporarily reducing traffic congestion. However, as congestion decreases, driving becomes more attractive due to faster travel times and reduced delays, leading other people to start using their cars more often or new drivers to enter the roads. As a result, traffic congestion returns to its original level or even worsens.

It's important to note that bundling can, in certain circumstances, have negative effects, such as reducing competition, limiting consumer choice, and creating barriers to entry for new firms. Therefore, the net social benefits of bundling depend on factors like market structure, consumer preferences, and the specific characteristics of the products being bundled. However, in the context of MaaS platforms it is unlikely that the expansion of the model would be welfare-reducing giving the existing public-private market structure and public policy goals central to its rationale. A very simple rule of thumb is that if bundling increases output, then it is likely to be welfare enhancing (Varian, 1985), and this is likely to be true for a well-designed MaaS platform service.[22]

[22] Varian (1985) was citing Schmalensee (1981) when he stated: "In particular, he noted that a *necessary* condition for price discrimination to increase social welfare – defined as consumers' plus producers' surplus – is that output increase". Varian generalised the result in his 1985 paper.

Appendix B iMOVE sponsored reports reviewed

TABLE E - FIVE IMOVE SPONSORED MAAS PROJECTS

Number	Project name	Project participants	Papers reviewed
1.	MaaS and On-Demand Transport - Consumer research and report.	ITSA IAG SkedGo	Hensher, D., Ho, C., Reck, D., Smith, G. (2020), The Sydney Mobility as a Service (MaaS) Trial, Design, Implementation, Lessons and the Future. Project Report for iMOVE. Project Number 3-003.
2.	MaaS business models: Emerging business models in the digital economy, and lessons for Mobility as a Service (MaaS) operators and regulators.	UniSA TFNSW	Vij, A. et al (2020), MaaS business models: Emerging business models in the digital economy, and lessons for Mobility as a Service (MaaS) operators and regulators. A report prepared for Transport for New South Wales (TfNSW) and the iMOVE Cooperative Research Centre (CRC). Vij, A. and Dühr (2022), The commercial viability of Mobility-as-a-Service (MaaS): What's in it for existing transport operators, and why should governments intervene? Transport Reviews, 42:5, pp.695-716,
3.	Mobility as a Service (MaaS) Trial: User Behaviour Analytics.	ITLS	June 2021
4.	Odin Pass: a Mobility-as-a-Service (MaaS) Trial at UQ St Lucia.	UQ	June 2023
5.	Design of a Regional Town and Rural Hinterland (RTRH) MaaS Blueprint.	ITLS, TfNSW	June 2023

Source: iMOVE CRC (supplied).