

The Future of Mobility and MaaS Governance and Orchestration



AUTHORS:



ADAM FARENDEN

*Senior Consultant |
Advisory Services*

adam.farenden@arup.com



TERRY LEE-WILLIAMS

*Principal | Transport
Strategy*

terry.lee-williams@arup.com

GLOBAL LEADERS



DAVID O'KEEFFE

Europe

david.okeeffe@arup.com



PÁDRAIG KENNY

Europe

padraig.kenny@arup.com



TIM GAMMONS

UKIMEA

tim.gammons@arup.com



DR. JOHN MCCARTHY

Europe

john.mccarthy@arup.com



**WILLIAM
BAUMGARDNER**

Americas

william.baumgardner@arup.com



RUSSELL WHALE

Australasia

russel.wale@arup.com



SAM CHOW

East Asia

sam-ms.chow@arup.com

WORKSHOP PARTICIPANTS:

Ireland

TII (Cathal Masterson, Roisin Barton-Murray, Eoin Gillard), **Emovis** (Francoise Riou), **NTA** (Barry Dorgan), **DTTaS** (Ray O'Leary, Faye Carroll, Sarah Rose Flynn, Naoise Greenwood), **Smart Dublin** (Alan Murphy), **Maas Global** (Adrian Ulisse), **MyTaxi** (Fiona Brady), **Stockholm School of Economics** (Gianluca Chimenti), **Dublin Bus** (Ciaran Rogan), **Arup** (Adam Farenden, John McCarthy, David O'Keeffe, Pádraig Kenny, Renata Lajas, Hanna Ratilainen, Orla O'Halloran, Colum Lynch, Brendan Tangney, Gerard Keogh, Paula Kirk).

Australia

TfNSW (Natalie Pelham, Jess Linsell, Dimi Rigas, Chris Bennetts, Dominique Winn, Peter Lee, Kellie Adlam, Michael Monaghan, Claire Richel), **ITS Australia** (Stacy Ryan), **Committee for Sydney** (Eamon Waterford), **City of Sydney** (Peter Warrington, Sebastian Smyth), **DPTI South Australia** (Joanne Murray, Jeremy Conway), **iMove CRC** (Ian Christensen), **RACV** (Matthew Barker), **Auckland Transport** (Cinthia Gillespie), **Transport for NZ** (Fergus Gammie), **Travelspirit** (Jeremy Dalton), **Arup** (Terry Lee-Williams, Caroline Traynor, Mark Rowland, Zoe Eather, Tom Blake, Ben Cooper-Wooley, Di Logues, Ryan Wong, William McGill, Ryan Falconer, Adrian Wiggins).

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THE FUTURE OF MOBILITY AND MAAS

Introduction

The world of transport and mobility is evolving, with the access to digital systems providing insights and efficiencies not previously available. Many trends and disruptions are beginning to highlight city-wide mobility challenges that need to be addressed.

The exposure of these challenges has naturally led to a number of technology-focussed innovations starting to proliferate into our towns and cities. As stewards for the built environment, Arup considers these challenges and opportunities daily.

In our efforts to 'shape a better world' we must act in the interest of upholding public value and consider the social, environmental and economic merits of developing our cities and places. In order to uphold public value and maximise societal benefit we must consider those stakeholders who will be most affected and in a position to benefit from changes to the status quo. Where necessary, government must be in a credible position to support those who may be adversely affected by change and ensure that the benefits accrued are realised by all system users, directly or indirectly.

The future of mobility, including the move from private vehicle ownership to the provision of Mobility as a Service (MaaS) is the derivative of such opportunities to revolutionise the way we move, and it promises to truly change our cities and transport networks as a result.

As with all opportunities, such a transition comes with risks; risks that must be adequately understood. Much has been considered from the perspective of technology and transport solutions by others, many of which were included within our literary review, but less has been considered from the perspective of governance.

This research begins to investigate some of the critical considerations we should be making on behalf of our cities, as well a number of MaaS specifics, identifying some of the areas we should be focussing on to uphold, maximise and optimise public value in the future.

This document looks not only at the opportunities and challenges that MaaS will catalyse but some of the wider possibilities of the future of mobility as a whole. As such some areas focussing on 'MaaS' will be city-focussed considerations of holistic future transport.



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Definitions



CAR-SHARING

Car-sharing is the joint use of a vehicle, owned by one or none of the users, on the basis of an on-demand need. Users may not necessarily journey together but given the shared nature of the vehicle asset must organise for use of the vehicle on a shared basis. These services distinctly differ from charter and vehicle hiring services.



DEMAND RESPONSIVE TRANSPORT (DRT)

Demand-Responsive Transport is any service that reactively responds to demand for mobility services on the basis of a request from an end user rather than a service with a fixed timetable and frequency. Such services include taxis, demand-responsive shuttle buses, car-pooling services and most ride-sharing services.



ECOSYSTEM

In the context of MaaS, the 'ecosystem' relates to the association and linkage between different aspects of the transport and digital environment. These can include the transport network, the political environment, the digital applications and architecture and any other element that is involved in the delivery of a successful mobility outcome as a service to end users.



FARE SYSTEMS

The Fare System represents the overall available fare arrangements across ticket and fare providers (typically public transport operators) including all discounted fares, integrated travelcards and other arrangements. The relationship between fare, ticket and journey is a complex one and must be simplified as far as possible, while maintaining the necessary accessibility requirements for customers.



MOBILITY AS A SERVICE (MAAS)

Mobility as a Service (MaaS) brings every kind of transport together into a single intuitive mobile app. It seamlessly combines transport options from different providers, handling everything from travel planning to payments.



PAYMENT SYSTEMS

Payment systems in the context of MaaS refer to the integrated system for the lodging of a payment from the user to the end operator, ensuring continuity, security and validity of payment across all parties. Payments are integrated to enable a single user session and maximise machine-machine sessions as far as possible.



PLATFORM

A platform is a product that serves or enables other products or services. Platforms that enable a business model have associated business ecosystems. They typically expose their capabilities to members of those ecosystems via an Application Programming Interface (API).



PRIVATE ORDERING

Private ordering refers to the culture and process of resolving conflicts of interests and aligning business objectives through a system not created by government (such as the legal or regulatory system).



PUBLIC TRANSPORT (PT)

Public Transport is often more synonymous with definitions of 'Mass Transit'.



PUBLIC VALUE

Public Value is represented by the net effect of achieving collectively valued social outcomes by the use of collectively owned assets and financial costs.



RIDE-POOLING

Ride-pooling is defined as the splitting of a single combined journey between a number of mobility users in response to a combined need to journey between a similar origin and destination. This service can be provided by a shared mobility provider or a private mobility provider. This is sometimes referred to as ride-splitting.



RIDE-SHARING

Ride-sharing is specifically defined as the provision of a mobility journey on the basis of a sharing arrangement between a vehicle owner and another member of the public. Specifically this differs from a licensed taxi-cab journey on the basis of the shared service element.



TRANSPORT SERVICE PROVIDER (TSP)

A Transport Service Provider is a party which provides end-user facing transportation services. These can include both public transport and private transport operators. Typically these have been used to define those parties that complement the public transport offering but given the potential for private operators to deliver public transport services, this term will cover all. Transport Service Providers are also referred to as Transportation Network Companies (TNCs) in many jurisdictions.



VALIDATION AND FARE GATE INFRASTRUCTURE

Validation and fare gate infrastructure refers to the physical systems that ultimately validates the ticket provided, links to the fare paid and provides access to mobility (through a gate or similar arrangement).

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Governance and Orchestration

- *Summary*

This research aimed to look at the future of mobility and MaaS from a perspective of society, to look not only at the challenges to enabling a MaaS ecosystem but the potential direct and indirect effects on the wider transport system and city.

Many items considered or highlighted are not only applicable to MaaS, but are applicable to many emerging forms of mobility- all however should be considered by government in order to maximise public value.

The key takeaway for this research is to encourage government and city representatives to continue to ask: 'Why?' Why should we support this and how does this mobility initiative support the betterment of public value? Much has been considered on how to achieve a future of mobility, but we must continue to strive for a publicly beneficial mobility ecosystem. Some of the summary considerations are as follows:

FOCUS ON MAXIMISING PUBLIC VALUE

Every decision has consideration points, positives and negatives, costs and benefits. Government bodies must ensure that they uphold the collective integrity of societal public value and ask the necessary questions of those who would seek to enter into a market utilising public assets. Engagement must be collaborative and constructive but ultimately, governments' aims must be to maximise public value.

RESPONSIBILITY AND LEGITIMACY

Government must focus on what it can, and reasonably should, positively affect. This is very hard to define but where government can establish its legitimacy, and feels it has a responsibility to uphold public value interests, it should ensure it holds a position from which to act. Early collaboration with market partners and transportation stakeholders is critical to ensure that the roles and responsibilities of government and private partners are clearly understood from the outset. Where legitimacy is assigned to partners by way of licensing, the responsibility of government becomes to ensure that this licence is operated according to the government's assigned responsibility.

BALANCE IS CRITICAL

Balance is reflected through all aspects of this research. Balance between public and private transport expenditure, between regulation and private ordering regimes; and between private TSPs and public mass transit. The future MaaS ecosystem must be constructed to enable this balance and ensure that a balanced system optimises public value.

Early collaboration with market partners and transportation stakeholders is critical to ensure that the roles and responsibilities of government and private partners are clearly understood from the outset.

INTELLIGENT PROTECTION AND SMART REGULATION

Enforcement of regulation and application of rigid legislation comes at cost, and the collective impact of establishing regulation should be weighed against the ultimate net public value benefit. Regulation and protection must be contextually relevant, applicable to the particular responsibility of government and established where government has a bona-fide legitimacy to regulate. In order to establish this remit of responsibility, government should collaboratively identify the key areas of risk to public value and construct regulations and protections on an efficient and tailored basis focussed on limiting the negative impacts of these risks. Where risk to public value is considered lower, the flexibility of protection and regulation should be adjusted accordingly.

PROACTIVE ENGAGEMENT AND CONSULTATION

Governments must ensure they engage early with other public agencies and market partners in order to prepare themselves for the commercial and social pressures of the future mobility ecosystem. Rather than reacting to enquiries and recommendations from the private sector, governments should ensure that they are suitably prepared, capable and legitimately able to act in the best interest of public value. Such practices transcend MaaS and transport but are the fundamental basis for effective stewardship of our cities and society.

SOCIAL STEWARDSHIP AND CONSUMER PROTECTION

We must all consider the ultimate public value benefit of the actions we undertake when considering the governance and orchestration of the future of mobility and MaaS. Focussing upon those most adversely affected, at risk and marginalised by potential change is critical.

Metrics and assessment for the ultimate benefit of action or inaction must be established to effectively quantify impacts to accessibility and social equity, and such impacts must be considered as important as effects of environmental and economic prosperity.

CONTEXT IS EVERYTHING

We must think of our transport and mobility initiatives, including the move to a MaaS ecosystem, as city initiatives rather than just isolated transport projects. There is no one-size-fits-all framework for how to regulate, facilitate or protect and optimise public value in all cities and we must therefore bring global lessons to a local context before applying broad-brush public or private solutions.

The city organism is far too complex, with too many variable elements, to allow for simplistic and generic responses. City partners and governance stakeholders must engage early with their citizens to establish what is needed for their jurisdictions, what is ultimately in the long-term best interests of the city and how best to make this happen. Be proactive, but don't rush governance responses that do not adequately consider the context in which the response will reside.

FLEXIBLE WHERE POSSIBLE, RIGID WHERE NECESSARY

Terms of reference should be established early between the city and potential mobility partners. Points of critical importance should be identified to denote key areas where flexibility is not possible in the interest of public value. On those points of potential development, match government regulation to the level of understanding, risk and maturity of the particular issue. Where understanding is low but further investigation is needed, consider flexible solutions with piloting.

Where risks are high but with proper consideration benefits could be also high, consider a long-term legislative development that restricts unregulated entry but allows for future amendments once understanding and particular needs are established. The tools and mechanisms for regulation are numerous, and should reflect the aims and needs of the public.

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MaaS from a Government Perspective

Much has been said of the definition of Mobility as a Service (MaaS)^{1,2} primarily from the perspective of market product developers and academic institutions, but little by way of absolute consensus is agreed.

Rather than try to pin a single definition of MaaS onto a government, we considered it would be beneficial to identify what the key characteristics and objectives of the MaaS ecosystem were from the perspective of government and as stewards of society and the environment. From our series of interactive government workshops in both Sydney and Dublin³ we were able to form a consensus around the following key concepts:

FLEXIBILITY

Access to a flexible array of transport modes and facilitation of multimodality was identified as the most important aspect of the future MaaS ecosystem. This flexibility trend was noted by Irish government workshop attendees. In the interactive workshops Arup held, key participants noted that flexible pay as you go services continued to increase across modes, whereas subscription-based products in their current format were reducing in popularity.

ACCESSIBILITY

Physical, societal and digital access to transport were seen as important features of the MaaS ecosystem. The ability to not only sustain but improve accessibility to the physically, financially or geographically disadvantaged was considered a major consideration.

USER FOCUSSED MOBILITY

Although acknowledging the existing customer-focussed transport design, it was considered that the future MaaS ecosystem should deliver a much more user-focussed and tailored approach.

DATA SHARING

Data sharing was considered to be both a prerequisite to development and a key benefit of a future MaaS ecosystem. There were obvious discussions around the associated security and data complexities that arise from data sharing but the consensus was that more data sharing will enable more intelligent and valuable customer insights.

CONVENIENCE

As with all multimodal transport environments, convenience of access and use was seen as imperative. The components of convenience were seen to be frequency, efficiency, service coverage, access to good service information and ability to easily interchange between modes.

DEMAND AND SUPPLY MANAGEMENT

Reflecting on government feedback, MaaS was seen as a catalyst to assist in demand and supply management. Combined with management initiatives such as workplace travel planning, road and congestion pricing and emissions pricing management, it was seen as an important vector by which to improve the overall efficacy of the transport network and cities.

Real Feedback outputs

Larger words represent more commonly agreed submissions from attendees.

CHANGE OF OWNERSHIP

It was noted that promoting a move towards usership rather than ownership of personal vehicles, and their 'vested interest' mode-share barriers was beneficial to public value.

INTEGRATION

Integration of both the transport network and payment systems were considered important. Data and payment system 'integration' was not necessarily in reference to the system integration definition but a need for federated systems to be able to easily interact without human facing sessions (M2M). Public-led integration of systems was specifically noted as unfeasible.

BETTER INFORMATION

Access to higher quality, real-time transportation and city information were seen as key opportunities within an aggregated mobility application. Supported by a robust data gathering and dissemination infrastructure, the future MaaS ecosystem would provide more relevant, accurate and useful transport insights to each and every customer inspiring user confidence and empowering better mobility decision-making.

COMPETITIVE MARKET

The engendering of a competitive MaaS marketplace was seen as an important property of the future ecosystem.



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MaaS and the ‘Strategic Triangle’

In order to investigate the role of government in the future MaaS ecosystem further, we need to consider the basis and role of government more generally. Mark H. Moore’s concept of the strategic triangle⁴, based upon his publications on the importance and intricacies of public value are important in order to frame the key aspects and foundations of the role of government in the MaaS enabled transport ecosystem.

Although targeted towards generic government activities, the framework is wholly applicable to transport governance and as such is a good basis for considering the challenges facing government in protecting public value in the future mobility paradigm.

Applying these theories to the potential future of mobility and Mobility as a Service (MaaS) ecosystem can enable us to focus on which areas must be upheld to ensure effective governance. The three focus points of Legitimacy and Support, Operational Capacity and Public Value form the fundamental components of the governance, orchestration and regulation basis of government.

Each section of this ‘Strategic Triangle’⁴ is considered important, and a deficiency in any one can undermine the efficacy of another. In this paper we will look to focus on the ability of government to protect Public Value in particular. It should however be noted that without Legitimacy and Support, and Operational Capability it is impossible to effectively protect Public Value. Looking at each pillar in further detail within the MaaS context, we summarise the following:

Legitimacy and Support

Government must align its aims and goals with that of its constituents, to ensure that the support of the people is upheld through it’s consideration of MaaS. Legal legitimacy of the role and remit of government must be established and formal democratic processes must be observed, employed and upheld throughout the course of governance. Where appropriate ,the neglected values of marginalised and latent constituencies should be included in order to promote social welfare and equality. The candid and pragmatic assessment of existing policy and standing with key stakeholders of policy should be considered in order to estimate the efficacy of government to effect necessary change, and where possible citizens must be viewed as co-producers in any change initiatives established.

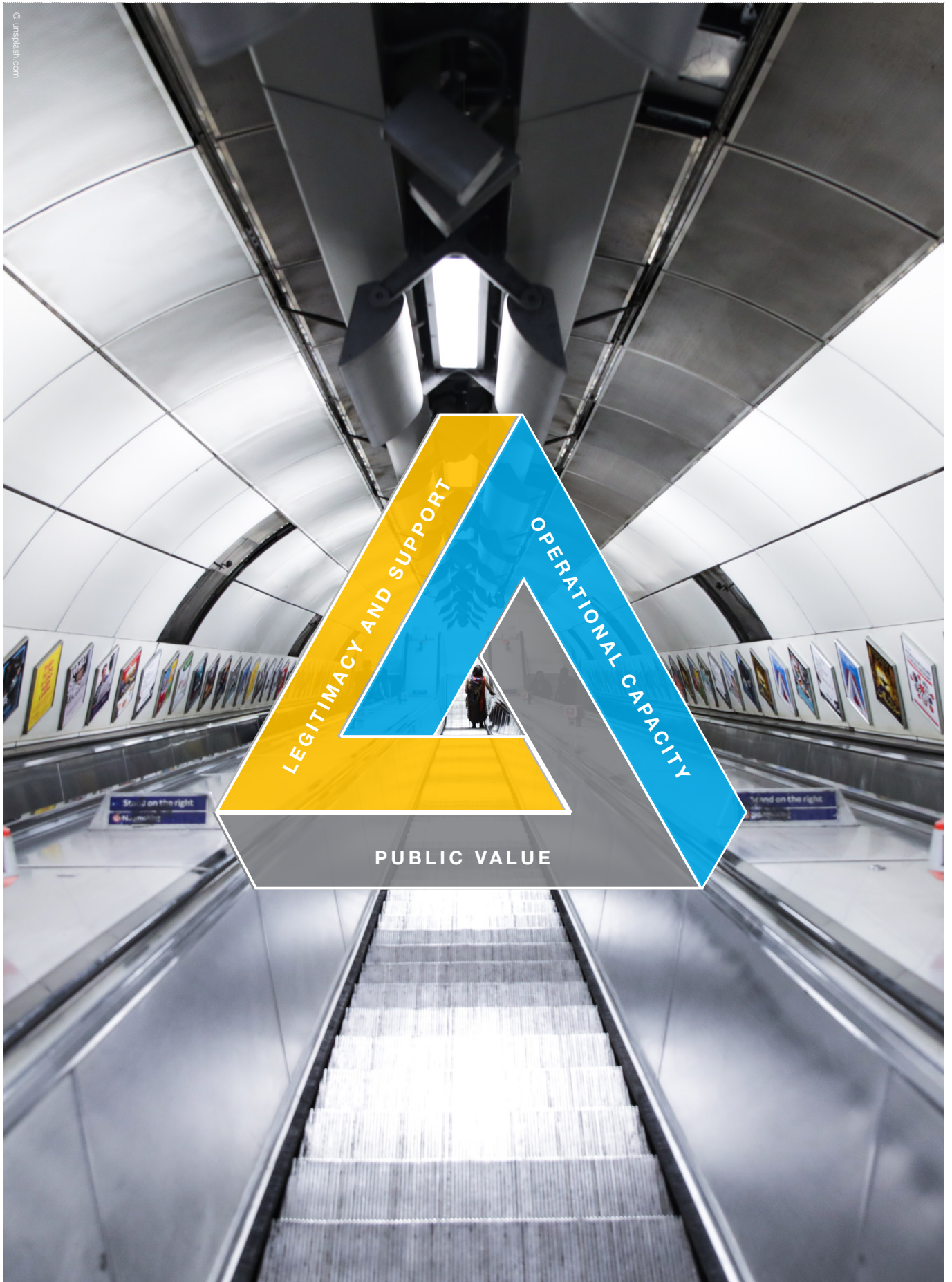
Public Value

Public value should be the core currency of government decision making with respect to MaaS and the future of mobility, and must be used as the benchmark for assessment in any decision making. There must be a balance between the use of publicly owned assets and financial costs to achieve the benefits of an integrated MaaS-enabled transport ecosystem, and the achievement of collectively valued social outcomes. We are exploring this balance in the context of MaaS in the following assessment.

Operational Capacity

A realistic consideration of the financial, human and technological resources of government should be undertaken in support of each and every aspect of governance in MaaS. The efficacy of existing policy, procedure and process to maximise the full public benefit potential of the future of mobility must be considered and where of ultimate value to the public, these existing institutions should be assessed for potential change.

Although this concept is applied to general government it is applicable to both governance of transport systems and private sector business models. The framework should be used for guidance rather than fixed, rigid assertions but it is useful to ensure that whenever we consider the governance and orchestration of MaaS we are thinking about the key pillars of effective government.



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Focussing on Public Value

Mark H. Moore's sub-category of the 'Strategic Triangle' relating to public value⁴ is split into an analogy of the Public Value Balance Sheet⁴. This illustrates on one side, the costs of utilising public assets to achieve desired outcomes, and on the other side the benefits associated with the achievement of those collectively sought social outcomes. It firmly and simply illustrates that there is no arbitrage in public value, and each incremental increase or decrease in public value must be balanced by a positive or negative change in collectively owned assets or financial costs. Utilising this framework we can identify the collectively valued benefits associated with the provision of an integrated - potentially MaaS-enabled - mobility system, and ensure we are always considering the necessary collective cost required in delivering these benefits.

Considering the future of mobility, and the catalyst for change that is MaaS, we can focus on the outcomes necessary to improve and uplift public value. Rather than simply looking at the needs of any one sector of industry, we can identify from a city level the costs to achieving an improved public value outcome and the benefits of ultimately embarking upon this change.

In order to balance the composition of net public value change, we consider both the use of collectively owned assets and implications on collective financial cost, and the achievement of a collectively valued aim. Such a balancing approach is applicable to all types of public value assessments but in the case of future transport and MaaS we will attempt to focus on the collective benefit of a move to a service-based transport model, and the necessary costs to achieve such an ecosystem.

Although our first-hand feedback from Irish and Australian government stakeholders has indicated that a move to MaaS is believed to be of benefit, we must be very clear of the costs to achieving this and as such, the net value to the public.

To support our analysis we have defined valued social outcomes and costs using Mark Moore's framework⁴ as follows:

Use of Collectively Owned Assets and Financial Costs⁴

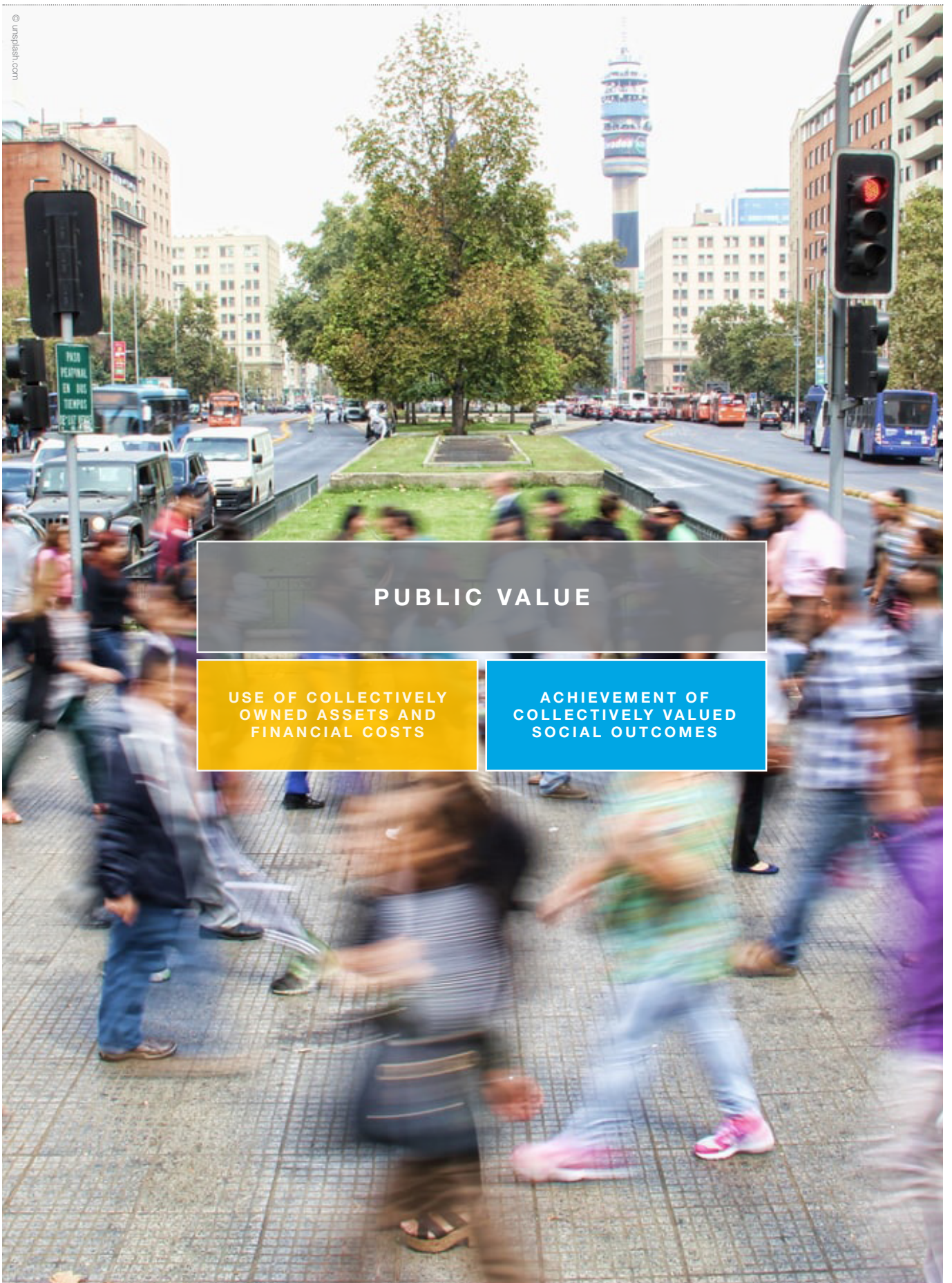
To define the necessary societal costs to achieving social benefit we must categorise related costs. Costs under this section include:

- **Financial Costs**
That being either the increased requirement for public subsidy or the necessary additional cost for items such as infrastructure to support and govern a publicly beneficial mobility as a service ecosystem.
- **Indirect Negative Consequences**
Any potential indirect negative outcomes that may arise as the result of governing and supporting a mobility as a service ecosystem. Many of these may be hard to predict but there are often negative consequences that are unintentional which must be considered.
- **Social Costs of Using Authority**
The cost associated with governing bodies seeking to or using their authority to govern a market or ecosystem. Such costs can be both tangible and intangible in their nature.

Achievement of Collectively Valued Social Outcomes⁴

One of government's aims must be the achievement of a number of collectively valued social outcomes, in order to be seen as maximizing value to their stakeholders (the public). Moore categorises these valued outcomes into:

- **Achievement of a stated mission**
That being the effective governance of a publicly beneficial future transport or mobility as a service ecosystem.
- **Public (Client) Satisfaction**
The satisfaction of service recipients and users is ultimately of importance.
- **Unintended Positive Consequences**
Any additional public benefit that may arise as a result of governance actions.



PUBLIC VALUE

USE OF COLLECTIVELY
OWNED ASSETS AND
FINANCIAL COSTS

ACHIEVEMENT OF
COLLECTIVELY VALUED
SOCIAL OUTCOMES

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The Public Value 'Balance Sheet'

To establish the composition of public value in a future mobility ecosystem, we began to construct a 'Public Value Balance Sheet'.

This process is very contextually sensitive, depending heavily on the mobility system in which it is applied. Although this is unlikely to cover all potential items of interest, this process allows us to clearly articulate the need for balance in the act of upholding public value, showing that all actions come with costs and we must decide through careful governance how best to apply any actions considered. It is noted that in many cases such costs and benefits are not only applicable to a MaaS or future mobility ecosystem, but affect many parts of the city transport system as a whole.

USE OF COLLECTIVELY OWNED ASSETS AND FINANCIAL COSTS	
Financial Costs	<ul style="list-style-type: none"> - Investment in additional fixed infrastructure to facilitate MaaS ecosystem - Additional direct cost for TSPs - Additional subsidy support for public transportation from public funds - Investment in MaaS related market education - Investment in additional governance, compliance and market regulation systems
Indirect Negative Consequences	<ul style="list-style-type: none"> - Potential loss of intermediary employment - Climate impacts through changed mobility modes - Potential disproportionate reduction in public revenues (tax, PT fare and patronage) to costs - Inefficiency during disruption and ramp up periods - Unintentional impacts to modal shift and congestion - Exacerbation of accessibility issues - Increased barriers to entry and 'walled garden' effects - Privacy and 'right to be forgotten' issues
Social Costs of Using Authority and Position	<ul style="list-style-type: none"> - Stifling of innovation - Perspective of utilitarianism vs individual outcome - Can undermine market confidence - Excessive use of resources vs quality balance - Perception of redundant bureaucracy - Trust erosion and control complex

The balance sheet looks to identify costs and benefits of developing and supporting a future mobility ecosystem, and consider the necessary actions required to protect public value. Each action of governance, regulation or policy must come at a cost, no matter how seemingly small, and in reviewing the course of action to undertake we must be cognisant of potential consequences.

This balance sheet process can be applied in many forms of governance planning and should be considered a fundamental course of action in any governance arrangements, not just in the future of mobility.

The balance sheet shown below represents a manageable selection of the potential identified costs and outcomes.

ACHIEVEMENT OF COLLECTIVELY VALUED SOCIAL OUTCOMES	
Mission Achievement	<ul style="list-style-type: none"> - Mobility accessibility increases across all demographics - Reduced congestion in cities - Increased levels of public wellbeing due to mobility opportunities - Sustainable public-private balance of transport usage - Reduced private car ownership
Indirect Positive Consequences	<ul style="list-style-type: none"> - A sustainable mobility market - Environmental impacts of mobility proportionally reduced - Reduced requirement for private vehicle ownership - Access to new streams of employment - Increased pt utility and subsidy efficiency - Additional indirect employment opportunities - Increased public revenue for hypothecation
Public Satisfaction	<ul style="list-style-type: none"> - Actively support the betterment of citizens and public life - Enhanced access to convenient mobility choices
Justice, Equity and Fairness	<ul style="list-style-type: none"> - More access to transport options with less negative impact on society, economy and the environment - Private solutions provide more public support for attractive public and mass transport services. - Pricing of options and rebalanced subsidies ensure efficient economic allocation of resources and greater access to opportunity for more people

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Identified Benefits to the Government

In order to validate our identified benefits and costs further, and place primacy on benefits of more importance, we undertook an interactive feedback exercise with key government officials³.

We asked attendees to consider a number of ‘industry accepted benefits’, identified from the literature review, and place importance against each item as they considered appropriate.

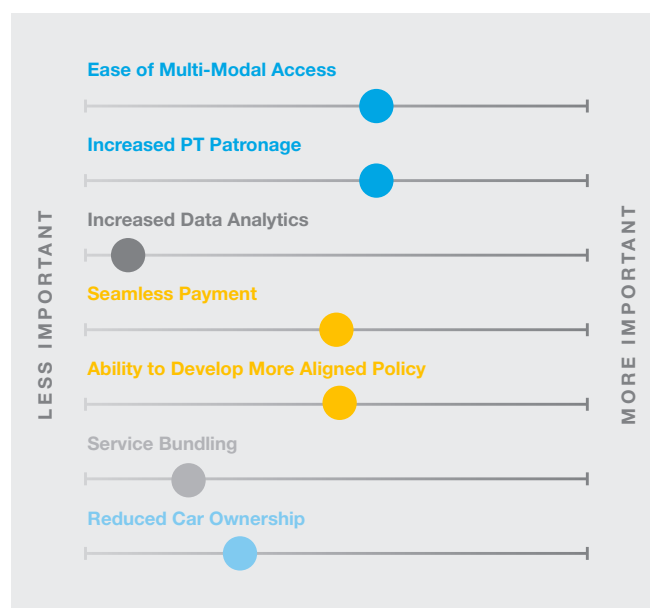
Feedback was provided via an interactive digital application and represents a consensus from a number of diverse, transport and city-focussed government groups.

The key benefits of a future MaaS ecosystem considered were ease of multimodal access, increased PT patronage, increased data analytics, seamless payment, ability to develop more aligned policy, service bundling and reduced car ownership. Although many other benefits have been touted, feedback on these issues was considered particularly important for government bodies.

The image to the right represents the outputted relative importance of each defined benefit from the perspective of government. Fluctuations represent the outliers and consensus forming around the ultimate value - akin to a deviation metric or variance of opinion.

Reflecting in more detail upon the findings, we can see that Ease of Multimodal Access and Increased PT Patronage were considered equal. Although access to multimodal services is clearly seen as a benefit to citizens, cities must continue to focus on optimising utility of public transport rather than simply promoting patronage increase.

While in many cases excess utility capacity in the system is available, we must be cognisant of the delicate yet real balance between public and private investment in transport. Maximising utility of PT systems will ensure that return on investment from public funds is optimised, and only when necessary are utility balances readjusted by an investment in large-capital capacity-generating initiatives. It is true that PT use is generally of use but in employing intelligent budgetary control for public investment, we must acknowledge the potential role of private sector systems and investment.



Although access to multimodal services is clearly seen as a benefit to citizens, cities must continue to focus on optimising utility of public transport rather than simply promoting patronage increase.

REDUCED CAR OWNERSHIP

Reduced car ownership was seen as less important than other factors. It was considered to be a tertiary outcome or resultant symptom of more important outcomes such as more convenient access to multimodality and increased PT patronage. Given that reduced car ownership is seen as a primary reason for the development of a MaaS ecosystem in other jurisdictions, namely Finland^{2,5} this development is an important factor for policy makers.

EASE OF MULTI-MODAL ACCESS

It was acknowledged that a key barrier to convenience, and ultimately transport mode use was the ease of access to multiple modes of transport on a single journey. This is a product of physically integrated transport, integrated digital payments and combined mode ticketing. This was seen to be the joint highest priority of the benefits considered by the group.

INCREASED PT PATRONAGE

Increased PT patronage was seen as a key potential benefit to a future MaaS ecosystem. For reasons including reduced congestion, increased public transport revenue and reduced environmental impact in particular this benefit was seen as a crucial, if not certain, MaaS outcome. This was seen to be the joint highest priority of the benefits considered by the group.

SEAMLESS PAYMENT

Akin to the ease of multimodality, and considered by many to be a crucial element of multimodal convenience, seamless payment systems were seen as being important. Integration with existing systems including the Leap (TfL) and Opal were seen as a potential opportunity but in any case, alignment of fares and ticketing with a seamless payment and validation solution is a necessary requirement of a successful MaaS solution.

ABILITY TO DEVELOP MORE ALIGNED POLICY

Although clearly focussed on the demographic of attendees, the ability for policy makers to deliver evidence and data-backed policy decisions aligned with both European and local legislative goals was seen as a potential key-benefit to a smarter mobility ecosystem.

Service bundling was not considered to be relatively important and increased data analytics was considered to be focussed through the development of more aligned policy.

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The MaaS Ecosystem

What words come to mind when you think of government in the MaaS ecosystem?

In order to identify what role government could play in future MaaS ecosystems, we asked a workshop panel of Irish government officials³ to provide their own feedback on what government in MaaS meant to them.

Such perspectives are invaluable in contextualising key stakeholder opinions on the pragmatic role of government, rather than simply attempting to identify what the perfect governance operation would consist of.

FACILITATOR

The key government role identified as part of the discussion was to act as a facilitator. This facilitation role was both from a technical perspective, and a stakeholder engagement standpoint. It was considered that government must act as an impartial arbiter of public value, focussing on the best outcomes for society and facilitating the system accordingly.

Acknowledging the pure public good nature of most infrastructure assets from which private profit can be derived, government must ensure that the required beneficial outcomes for the public (owners of pure public infrastructure) are protected. Such a role is analogous to a board of directors, ensuring that public shareholders receive the applicable return on their societal investment. This is not to undermine private profitability but is to facilitate an environment that is conducive to the protection of public interests foremost.

PROTECTOR

The government was seen as a protector of the vulnerable, in particular from a social perspective. This mission is a subset to the overall regulatory responsibility of government but should not be underplayed. The government is duty-bound to ensure the necessary mechanisms are in place to not isolate, penalise or undermine the equality of all members of the public to have equal access to opportunity through the mobility ecosystem.

TRUST

Trust, rather than a responsibility, was seen as a constant defining requirement of government in the MaaS ecosystem. Without trust earned through honest, transparent and fair regulation combined with a robust clarity of responsibility for government – market coordination and governance is inefficient. Lack of trust in the government, be that through ineffectuality (leading to the excessive capture of Public Value by markets), illegitimacy (leading to private investment aversion) or excessive enforcement (leading to the excessive capture of private value by regulators) all lead to a substandard value balance outcome.



CONFLICTED

Interesting perspectives were raised around potential conflicts of public bodies in governing the MaaS ecosystem. This raised valid points of the extent of regulation and ensuring that at all times, governance and intervention is legitimate, proportionate and public value beneficial and does not inhibit innovation.

REGULATION

Regulation was seen as the key overarching mechanism by which government can affect the necessary changes upon a MaaS and future mobility ecosystem. This must be founded upon a fundamental legitimacy to regulate, which itself must be established by appropriate legislation and public ordering early on. Regulation on commercial practices of mode incentivisation, the use of public assets to derive private gain, accessibility, public safety and the upholding of customer experience are key. Government should review existing bases for regulation in markets such as telecoms, electricity and other digital services to inform the development of regulation within this evolving market.

Fundamental regulatory integration within solid transport economics and urban planning legislation will be crucial in establishing an effective and fair means for market coordination.

INVESTMENT

It was noted that as a sub-responsibility of facilitation, investment support is required from the government. Clarity was sought as to the focus of this investment, and further consultation will be required to establish a consensus basis for this. In response to this point, investment from public entities may be best focussed upon the areas of responsibility that government has direct control over.

Government has long been a source of great innovation investment globally but in specific consideration of the Irish market and given the capital availability and challenges, direct investment should be focussed on the fundamentals of the transport network promoting integration and multimodality.

These perspectives have been used to inform some of the challenges and opportunities faced in the governance of a mobility as a service ecosystem and help to establish a target operating model for mobility governance that considers the real concerns of government stakeholders.

Although not all-encompassing or universally applicable, the Irish government opinions³ reflected well with workshop feedback from Australasia³.

THE FUTURE OF MOBILITY AND MAAS

The Role of Government in a MaaS Ecosystem

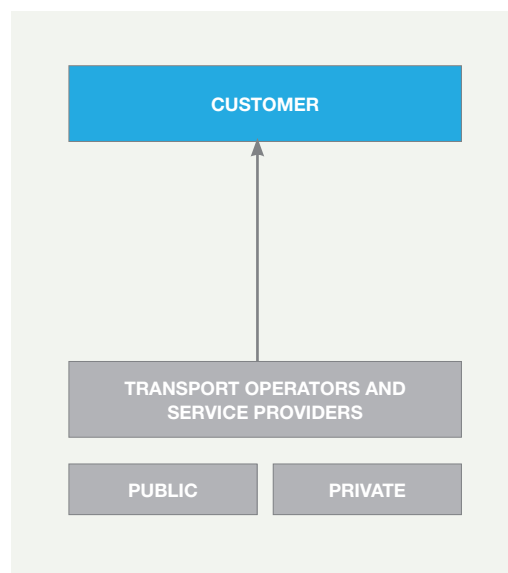
When constructing a target operating model of government within the MaaS ecosystem we must consider the value chain of both existing mobility systems and potential future models. No single model has yet been agreed, or is likely to be agreed in the near future.

The myriad variables, market ‘players’ and stakeholders involved in the value chain make it impossible to determine a ‘one-size-fits-all policy’. Some market-led proposals are able to perform the role of a single integrator of standards, data and information^{6, 7, 8} opting instead to acquire and process information via agreements and APIs on a typically bilateral basis. Other public-sector led products have led by integrating all transport and payment related information under one roof^{7, 9, 10, 11, 12, 13, 14, 15, 16}, opting instead to provide only nominal routing, scheduling and ticketing information to external MaaS providers. Considering the ultimate mobility value chain can begin to unlock some of the particular questions we wish to answer.

The traditional value chain, the provision of mobility services on a direct basis, is linear and can approximate to two stakeholders with distinctly different value propositions, the Customer and the Transport Service Provider (TSP)¹⁷. The Customer agrees a fee with the provider of the service and the provider in turn fulfils their service obligations. The agreement between the Customer and TSP is bilateral and direct.

Two potential new roles are expected to emerge to enable and aggregation of service types and provision of multimodal MaaS from the current detached value chain:

- MaaS integrators that assemble the offerings (data) of several transport providers, and
- MaaS providers that package and deliver these offerings (MaaS) to end-users.



Current Mobility Value Chain

17Göran Smith, Jana Sochor, MariAnne Karlsson—Mobility as a Service: Implications for future mainstream public transport, Chalmers University (2017)

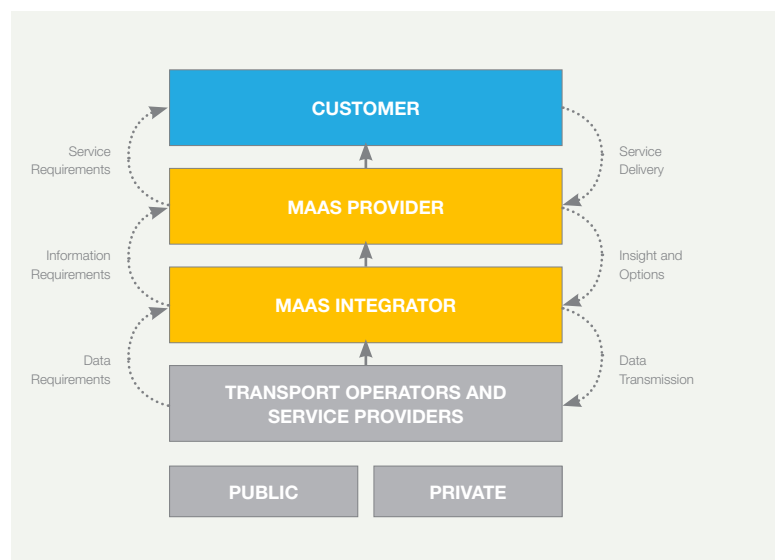
The extent to which private enterprises fulfil one or more of the roles in the MaaS value chain, will depend on government policy and market conditions. Government or private entities could operate across one or more of these roles, depending on the prevailing market structure, sentiment and value to undertaking the inherent responsibilities. The integrator and operator roles may be filled by existing players or by new players.

What must be considered however is the ultimate benefit to the Customer and User of multiple providers and integrators in a single market. Partial aggregation of some services with multiple MaaS Operators requiring multiple MaaS products for each Customer may create competition, but ultimately we should consider the public value benefit, employing a balanced perspective. In such a scenario TSPs are often forced to choose a platform with an exclusivity clause, or if not, they may have to pay a higher rate to the MaaS provider to be ‘on’ their platform. In such cases, the ability to have competition of providers in a single place with information asymmetry is lost, costs can be higher for both the TSP and the customer, and the convenience of a single provider also evaporates. There is a fine line between competition benefit and an inefficient allocation of resources to satisfy provider ‘disaggregation’. Governments must therefore be cognisant of the risks and benefit of constitutional monopoly and also to the risk to TSPs and users through an overly complex and disaggregated provider market.

Each government, on an individual jurisdiction basis, must consider its market aims, its organisational capabilities and its city aspirations before taking responsibility for one or more of the above roles.

However, regardless of whether it takes a direct role or not, government must ensure it has the ability to affect necessary change in the market to support the upholding of public value through protection, regulation or incentivisation.

Government’s role should be to focus on where it can most efficiently and effectively maximise value to the public through cross-market investment, fostering inter-stakeholder collaboration (public and private) with supportive policies and regulations and, where necessary, eliminating public value destructive behaviours through enforcement and market intervention.



Conceptual MaaS Value Chain

Base Diagram Concept: Göran Smith, Jana Sochor, MariAnne Karlsson – Mobility as a Service: Implications for future mainstream public transport, Chalmers University (2017)

GROCERY SUPPLY CHAIN RESILIENCE

The Role of Government in the MaaS Ecosystem - *Feedback*³

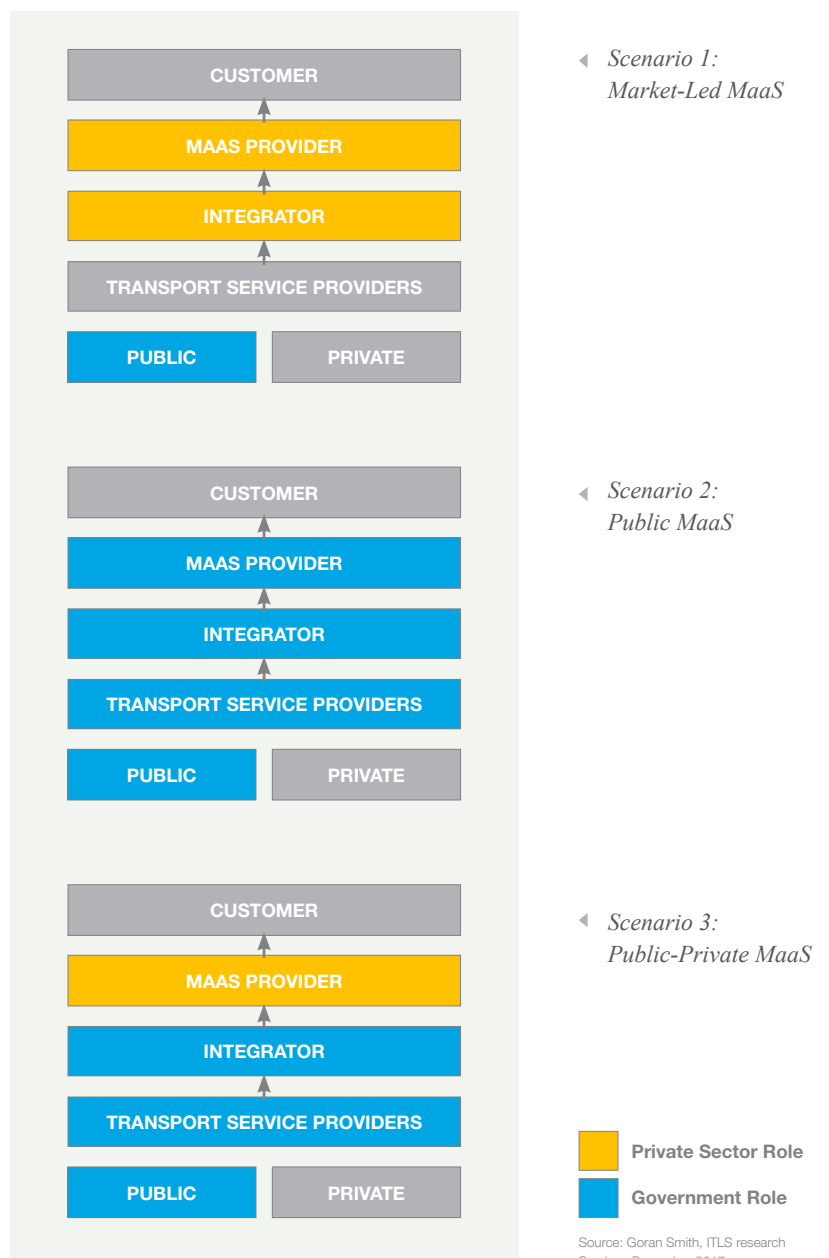
Which general model do you think is best applicable in an Irish context?

ATTEMPTING TO FORM A CONSENSUS

Through simplified examples presented at our Dublin workshop, three models for overarching governance of the MaaS ecosystem were assessed in an Irish context. These models represented a public led MaaS ecosystem, a 'market' driven approach (albeit a market approach facilitated by public collaboration) and a hybrid public-private ecosystem.

Significant debate was held around the particulars of the simplified models. Indeed, it was apparent that, as expected, simplification is not a viable method by which to consider the most appropriate solution. Context is imperative, and it was acknowledged that no single simplified solution was definitively applicable to the Irish/Greater Dublin Area market. This was specifically manifested in the 'another scenario' vote.

Consensus was formed around the requirement for definite collaboration between public and private providers. It was generally agreed, although not unanimously, that the government transport authority is best placed to regulate the overall transport system – including both public and private TSPs. It was believed that considerable public value could be undermined if a government body was unable to legitimately govern the balance of transport mode use, and put in place incentives and mechanisms to balance the most beneficial transport modes.

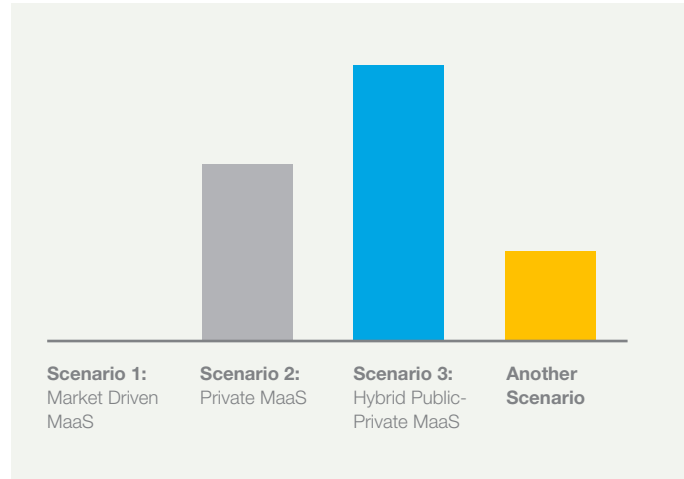


This was not an advocacy for complete central control, but to establish core rules that restrict the ability for private TSPs to excessively incentivise or promote transport modes that may undermine the collectively public good. This should not limit the ability for private providers to offer alternative services, but must look to eliminate the risk of unstable and incomplete transport service markets.

It was agreed that under a public form of MaaS there would still be a requirement for significant input by private TSPs. The aggregation of data and services from TSPs could be promoted through a single public MaaS product, and use of the Leap card system could be established. It was not however agreed that this is a definitively better solution, especially with regard to the use of Europay Mastercard Visa based payment systems in addition to the Leap NXP Semiconductors N.V. smartcard technology.

The fundamental takeaway was that there is a definite requirement for public-private collaboration, and simple broad-brush 'integration' of systems was not seen as an effective or practicable means to achieving a publicly beneficial MaaS ecosystem.

The role of integrator was difficult to define either as public or private, and specific 'integration' roles were established for each. It was noted that public systems integration in particular was of limited benefit to a wider mobility market, and that a federated system model would be more appropriate to a central 'integrator'.



Feedback

Irish government stakeholder respondent's feedback on the potential optimal ecosystem structure, gathered from workshop attendees.

THE FUTURE OF MOBILITY AND MAAS

The Role of Government in a MaaS Ecosystem

Through our interactions with various stakeholders, principally government transport authorities and private sector mobility providers³, we identified a number of key areas of contention.

These areas were focussed around the role of government both in general and in a future MaaS ecosystem. Although the points of discussion were too numerous to expand upon in their entirety, we wish to focus on four key areas of debate. There are clearly more than just four, but we believe these to be worth discussing further in this initial case:

GOVERNMENT AS THE DE-FACTO INNOVATOR

Governments have a key role to play in promoting and supporting innovation, and with the proliferation of MaaS this will continue. Leyden & Link¹⁸ note in their heralded book ‘Government’s Role in Innovation’ that ‘innovation has long been recognised for providing benefits to society far beyond those that accrue to any particular participant in the private sector, and for being an important contributor to economic growth’. Cohen & Noll¹⁹ note that western, in particular American, public policy has long held the belief that technology growth will expand resources ahead of exponentially increasing demands.

Leyden & Link¹⁸ and Cohen & Noll¹⁹ further back up the view that this has led to governments assuming the best course of action to solve a ‘serious national problem’ such as population growth, congestion growth or food shortages is to ‘throw technology at it’. In recent experiences within the MaaS sector this is indeed the case, with the underlying assumption being that because there is a

technology under development that this will solve societal issues such as congestion, emission related health issues, land use efficiency and even climate change itself.

Technology can help but government’s role must be focussed on the targeted support of innovations and behaviours that benefit the public good. Accepted roles for government to achieve this goal include:

- The creation and maintenance of a legal framework and environment that encourages private sector investment in publicly beneficial innovation (including the legitimisation of patenting and anti-trust regulation).
- The provision of incentives to innovate in the public good, rather than simply focussing on shareholder value. There are many levers and mechanisms to enable this.
- Promoting the importance of an innovation culture within the public in order to foster support for publicly beneficial technological advancements.

Government, and any other stakeholders, must be cognisant of the fact that technology is but a means to an end goal of improving the cities and lives that we lead, reducing environmental impact while uplifting social normality. It is not an end in itself and should not be invested in as such by governments.



Government should focus on assisting private innovation to scale to whole markets by supporting and focussing on platforms by which they can deliver their offerings on a market-wide basis – transcending any single market private sector offering.

LIMITING CENSORING OR RESTRICTING INFORMATION AND DATA FLOW

Open Data access, even at its most ethereal and undefined, is well documented as providing added value to global economies, as can be seen in Doody, et al.²⁰, Manyika, et al.²¹ and in publications from the Open Data Institute²². Although there are significant challenges to the facilitation of open data in transportation systems, some of which we will expand upon, a number of reputable sources cite significant public benefit to be derived from the provision of access to open data. Arup in particular notes in their report ‘Urban Mobility in the Smart City Age’²⁰ that global economic value of USD \$720 to 920 billion per year could be generated by utilising open data to develop new digital transport applications. In support of this, the Shakespeare Independent Review of Public Sector Information (PSI)²³ estimated a potential benefit of around 0.4% GDP for the UK alone.

The requirement to provide open data has not to date prevented industry desires to enter the MaaS marketplace, either at the MaaS platform provider or Transport Service Provider level. While consistently opposed by the great majority of potential entrants in those markets where it is not a choice, the participants have still chosen to enter.

A benefit rarely discussed, but accruing in the most part to the private sector, is the opportunity for open data sharing between public and private entities to increase public support of private enterprise. If a government has full access to movement data, for example, it can identify more opportunities to either procure more services from the private sector, or even reduce its subsidised competition of transport service providers. If communicated and employed on a collaborative basis, this can be a powerful advantage to private sector actors’ interests while upholding a net public value increase.

It is obvious that restriction of access to information by any party creates an information asymmetry within the economy, which in turn undermines public value. Empowering transport users and customers to make smart and informed decisions about how they wish to move, and facilitating that movement seamlessly through well-delivered and implemented initiatives such as MaaS is the future. Ultimately this information empowering leads to an efficient allocation of economic resources and user time which in turn increases value.

Government must therefore strive to provide as much open data as possible within the bounds of system practicalities, privacy and security. Open data should by no means be confused with lackadaisical data handling however, and we will discuss the importance of data use, processing and handling regulations further.

EFFECTIVE SUBSIDY AND CENTRAL MARKET SUPPORT

Government’s role is to subsidise private profitability should only be employed where it ultimately benefits public value. There exists a fine line between subsidising an ecosystem that allows private businesses and franchises to thrive and provide public benefit, and directly supporting the ongoing concerns of unsustainable business models providing limited public value. An in-depth understanding of the accrual of benefits from incentivisation and subsidy in the context of each market is paramount to ensure the effective allocation of subsidy.

Gordon Tullock, the world-renowned economist, stated²⁴ that the benefits derived from subsidies are traditionally transitional, and therefore those who can quickly take advantage of the new subsidy scheme will gain the most benefit in the longer term. The application of this logic in a market such as mobility can be quite different, but in the context of mass and public transit the fundamental concepts remain valid.

\$920bn

a year could be generated by utilising open data to develop new digital transport applications.²⁰

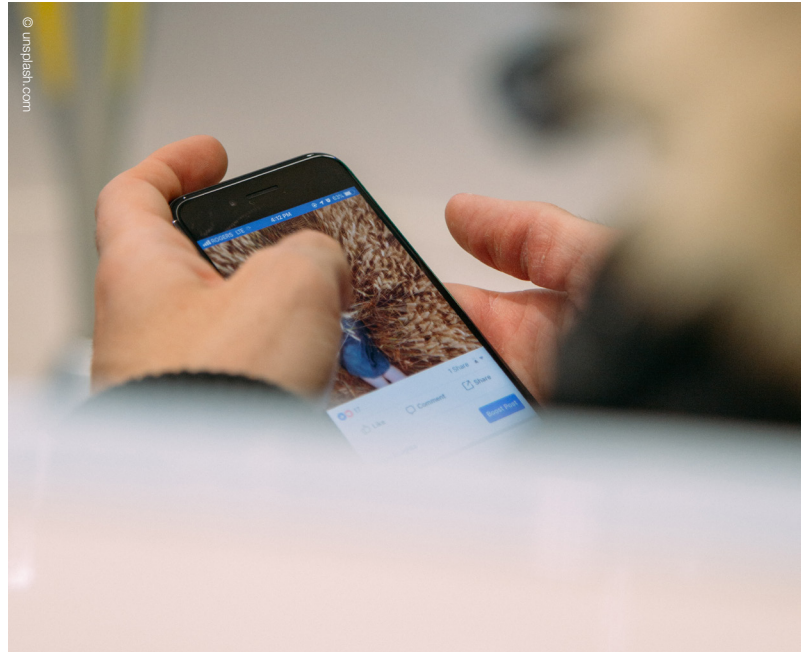
0.4% GDP

estimated potential benefit for the UK alone.²³

Early or established entrants into the Public transport, DRT, Bikeshare, Carsharing or MaaS Platform markets will benefit more significantly than late entrants. As Parry & Small²⁵ notes, transportation subsidies are overwhelmingly socially beneficial. Public value stewards must maintain their fiscal awareness and operate as any private investor may in providing the necessary social outcomes, but as Moore²⁶ states not, ‘give away the store out of faint-heartedness or an insufficient understanding of one’s own rights’.

Although the benefits of franchise support have been illustrated in numerous projects globally, incorrectly managed monopolies consistently undermine public value and can ultimately lead to elevated barriers to entry and potential isolation of the socially marginalised. In particular regard to MaaS and TSPs there remains a trade-off between subsidising crucial societal backbone transport systems such as bus and rail/metro systems, the use of integrated payment systems and the potential elements of first-last mile transport offerings.

The advent and implementation of MaaS has the potential to supercharge efficiency of transportation systems and radically change the way we purchase mobility services and redistribute social subsidy either to an individual to procure from the market, typically via the taxation system, or to shift subsidy to a more efficient deliverer. Whether the result is ultimately to the benefit of society is yet to be determined. Governments must tread carefully to not force the proliferation of MaaS upon the economy via over-subsidisation of either MaaS operators or TSPs, but also provide the necessary support where it is ultimately beneficial to the public good on a case by case basis.



PROMOTING AND UPHOLDING SOCIAL EQUITY IN THE FUTURE OF MOBILITY

MaaS is seen by many as a catalyst for future mobility, and when considering its potential impact on social equity we will therefore look at the whole of the mobility system, not just the product of MaaS itself. As government and city stakeholders, we must strive to look not only at the service in front of us, in this case MaaS, but the ripples and impacts it may have throughout the system we have responsibility for. Social equity can have many facets and factors, and can be affected by a myriad of non-transport related issues. We will not cover all potential social equity impacts and permutations, we will however look to highlight what we consider to be some of the most prevalent and high-risk items in relation to the future of mobility, MaaS and social equity within our cities.



SOCIAL EQUALITY VS SOCIAL EQUITY

Social equality considers the idea that every individual within a governed society receives the same opportunities, support and resources with no discrimination or reserve²⁷.

Social equity denotes separately that each person should have access to the amount of opportunities that they specifically need²⁸. Thus, indicating an acknowledgement that in society some citizens require access to differing levels of resources either through accessibility, disability or differential socio-economic standing.

Considering this, governments should look to provide the outcomes necessary for their various cities to thrive. One solution cannot suit all parties, but similarly an equal minimum benchmark must be considered. We will therefore look to highlight some of the key special circumstances that transport and mobility authorities should look to address in the future of mobility and the evolution of the MaaS ecosystem.

Government must establish mechanisms and coordinated mitigation - legal and economic - to limit any negative effects on equity that a move towards a MaaS-accelerated transport ecosystem may generate.



ABILITY TO PAY

Affordability Risk

Should the vast majority of reasonably demanded services in an area be outside the realms of local affordability, regulators should work with TSPs in order to consider the potential societal and economic benefit in providing financial support. The means by which this support can be provided are both direct and indirect. Direct income support, discounting arrangements or subsidy can be provided either to residents or service providers in order to control the local cost basis. It should be noted however that such measures are highly complex in their planning and application and the impacts of such support should be closely considered and monitored.

In addition to provision of financial support, there is the provision of additional services. These services can be public and private and need to be assessed on a case by case basis. Factors such as land-use and availability, funding source, existing system utility, established infrastructure, city integration and customer preferences are key. Consideration as to whether new services or capacity are required or an increase in utility would better serve the public need should be established. Ultimately the provision of alternatives should empower citizens to make smart mobility decisions based upon their budget.

Citizens should not be excluded from society simply because they cannot reasonably afford to use suite of transport systems available to them.

Access to Financial Systems

Although typically correlated to or caused by level of income, access to financial systems can also be restricted by other factors such as availability of permanent employment or access to a fixed abode. Governments and TSPs alike should be cognisant of such realities and establish systems and minimum regulations accordingly. Through the advent of mobility as a service we must ensure that citizens are not isolated from traditional means of transacting, on a cash or non-digital basis. Such considerations should also serve to support those who are not digitally literate or are unable to afford digital devices such as smartphones.

No member of society should be unreasonably excluded from the opportunities that transport should provide them simply on the basis of an inability to access modern financial products, and MaaS should not be an exclusive means by which to exclude such persons from transport further.

Socio-Economic Stratification Risks

With the move towards an aggregated service provision and a customer focussed model, there is a risk that services become financially and demographically stratified and segregated based on geographical area, disposable income or social status.



The creation of tiers of services available to some customers but not others is a realistic prospect, that is often brought on organically and as a result of many externalities.

Commercial suggestions of varying levels of service based on cost are reasonable but regulators and service providers must ensure that this is an increased level of service based upon an acceptable minimum, rather than a binary ‘have or have-not’ provision of transport services.

It should be noted that MaaS is an opt-in service, and as a result there must remain the option to use existing services without the use of a MaaS application. Such transitional periods are more expensive to administer but are fundamentally necessary to ensure that direct access to existing services, particularly public transport, is maintained.

Stratification of access to mobility can also be geographically driven, itself often a product of social demographics of course. Provision of exclusive services to, or omission of services from, particular geographies is a fundamental indicator of stratification. Although natural points of gravitation will occur, and some areas due to their economic value and population densities will be served more heavily than others, planners and regulators must ensure that adequate service options are provided to the whole population on a payment basis that is reasonable and relatively affordability to their needs.

PHYSICAL ACCESSIBILITY

Physical accessibility is a product of both fixed infrastructure and transport service provider vehicles – determined by a fundamental culture of equity, equality and fairness. We must strive to provide the means by which those with physical impairments can continue to access our transport systems and society. We must however balance the requirement to provide sufficient amenity with the practicalities of service provision.

Regulation and Enforcement

Minimum specifications and service provisions by TSPs can be very complex, especially when considering physical accessibility. Minimum benchmark standards for fixed infrastructure have their challenges but are more easily developed and delivered. When, for example, we are considering a fleet of vehicles we must pragmatically assess both the demographic split of users and the availability of fully accessible vehicles. This must consider the financial implications of regulating a minimum benchmark, where these financial implications will manifest, and the availability of such vehicles in the technology market. We must also, so far as is possible, ensure the application of such legislation is fair and homogenous across related TSPs.

An example of this is the application of physical accessibility regulations in the taxi and ride sharing market^{29, 30}.



In most developed city jurisdictions taxi services are regulated to provide a fleet that is either proportionately or in its entirety physically accessible. The impact of such regulations is considerable, and although necessary, they place a significant cost burden on taxi providers themselves. Ultimately these costs are reflected in the bottom line of fare costs which are passed back to users through the system. To date, many developed jurisdictions have not enforced such regulations on ride-sharing service providers.

Given the state of competition that exists between licensed taxi services and unlicensed ride-sharing and hailing services this can provide a significant competitive cost-advantage to the latter. If taxi services do not enjoy institutional monopoly privileges in the jurisdiction regulated, it can therefore be very hard to fairly and equally enforce physical accessibility regulations on both services. This leads to service isolationism for physically less-able customers, forced to only use the more-expensive taxi service. It also reduces the number of vehicles ultimately available to physically less-able customers which undermines quality of service and time in travel.

In an economic system resources must be efficiently managed, and if regulators are not very careful, such blunt and blanket approaches to regulation can lead to inefficiencies and excesses that undermine the overall public value of the transport system.

Integration of the Transport Network

MaaS is an aggregation of multiple modes of transport, and from a physical perspective this aggregation is most efficiently served by an integration of the transport network and its modes. Alignment and co-location of key transport hubs, fed by services that consider users' first and last mile approach along key movement corridors, can best achieve the aims of both MaaS and the transport system – to seamlessly, enjoyably and conveniently move people around the city and provide them the access that their lives require.

It is therefore imperative that in designing the physical elements of the transport system that the ethos of aggregation, integration and convenience be applied throughout, therefore aligning the digital design approach of MaaS to the physical design of the infrastructure network.

Access to Opportunity and Society

Transport systems and the wider mobility ecosystem are providers of access to society and the opportunities it offers. It is the means by which people get to work, school, socialise, shop, access culture and participate in society. It is a fundamental staple of all citizens' lives, and therefore is a mechanism by which to deliver considerable change into the daily functions of all people. Governments must therefore be extremely careful in changing the means by which citizens access our transport systems, and ensure that human factors and customer centred design are at the forefront of all change initiatives.

Transport services via private MaaS providers should not be the only means by which we travel. MaaS is an opt-in solution that provides benefit to users through economies of scale, service aggregation, data-backed-intelligent decision support and payment-ticketing integration. It does not, however, form the basis of the transport system and therefore all citizens should continue to have access to the transport system on their existing basis during transition periods.

As noted in the Ability to Pay section, many members of society could be excluded from the transport system if only a private MaaS system is available. Therefore, governments and TSPs alike should continue to ensure that PT services in particular continue to be available through their traditional avenues to a comparably good level of fundamental service.

THE FUTURE OF MOBILITY AND MAAS

Mobility Market Failures

Government Focus

Although it is accepted that the government's role is not to dictate or coordinate the market, it is the responsibility of government to protect its citizens from market failure if the failure of that market is detrimental to public value. To this end our consideration of governments' responsibility will extend to the protection of public interest in the prevention of damaging market failures, focussing in particular on failures brought about by information asymmetry, monopoly, unstable markets and incomplete markets.

Government must ensure they understand and reasonably mitigate against value-destructive market failures that may be catalysed through the switch to a digitally enabled, transport economy.



MONOPOLY

Monopoly occurs when one party has uncompetitive levels of market power due to specific circumstance³¹. This can occur for almost all agents in the mobility ecosystem, with information, payments and services all holding prominent share in the service flow cycle. Key sources of monopoly include:

- Payment system and transaction platform access
- Transport data and allocation algorithm access
- Licensing, service provider and operational monopolies

As of 2014, 90% of fare payments in the United States were made on closed-loop payment systems³². Access to the details of these transactions can be precluded on contractual basis. Furthermore, payment systems for these transactions can attract significant and unbalanced premiums. Lack of transport data sharing and opaque TSP allocation algorithms can limit fair allocation of transport modes and limit ability to analyse the health of the system. A number of MaaS products being brought to market are being directly challenged by such value erosion or are propagating monopoly as a means to achieve operation. Although such compromises can seem pragmatic in the short term, long term public value can be seriously undermined and lead to sub-standard outcomes for our cities.

Further, if public bodies are unable to ensure the fair allocation of trips and monitor price accordingly in order to maximise public value then there exists a route to manipulate the modal choices of the customer to disproportionately affect profit. This would lead to an ultimate failure in the ability of the transport system to adequately allocate its finite resources. Operational and licensing monopolies can equally exist where the ability to provide a service is restricted by an allocating entity. If this entity restricts reasonable market entry from new entrants, this could limit the maximisation of value.



It can also however provide certainty (as is the case with existing high-cost to entry PT systems) and control to markets that are developing an inherent instability.

Given the relatively low capital investment costs for most entry level transport service providers outside of mass transit (buses, light rail and trains), there is far less justification for governments to create competitively allocated state sanctioned monopolies. These additional services are typically of lower criticality.

However, governments might still see fit to subsidise some part of the ecosystem to lower the barrier for entry to enhance competition.

In order to limit negative effects of monopoly, government agencies and custodians of public value must proactively identify the outcomes they wish to achieve from engagement with market partners, and ensure that they are technically, financially and legally aware of the impacts that monopoly can have in their jurisdictions. Where necessary, information sharing requirements and performance reporting should be legally enforced between service providers and the city via by-laws, licensing agreements or bilateral contracts.

90%

of fare payments in the United States were made on closed-loop payment systems as of 2014. ³²

INFORMATION ASYMMETRY

Asymmetrical information environments are prolific within the emerging mobility and MaaS ecosystem, with MaaS Providers, Transport Service Providers (TSPs), Governments and Customers all having access to varying degrees of information about their service or journey. Further fear exists around the ability for TSPs and MaaS Providers to artificially manipulate the best service offered to customers and therein dictate the efficiency of the transport system to support their own ends.

In instances where private services are provided on a private sector basis, government's place is simply to provide consumer protection and ensure that consumers are not manipulated in the process of service allocation. In this case government should set minimum consumer protection benchmarks, as with any service or goods provision, that stipulate clearly that services provided are commensurate with the payment provided and information on services is provided on a necessary minimum level. However, within ecosystems that integrate publicly funded, endorsed or administered transport services, government has an obligation to ensure that consumers are not manipulated or dictated without their knowledge-typically through an information and service provision mechanism.

Regulation may be required if a MaaS provider or TSP does not adequately present or provide trip or pricing data or pushes services that are ultimately at odds with a public value benefit. The power of explicit or tacit endorsement created by government association can be powerful in many markets, and it is in these cases that protection is most required. Protecting the trust in government services to operate fairly and promoting socially useful behaviours both justify such interventions.

Such situations can rapidly create large surpluses in the MaaS provider and TSP value balance and ultimately lead to an undermining of trust in both the governance and fairness of the MaaS market.

MaaS providers and TSPs therefore have an obligation to ensure that information asymmetry is promoted within reasonable and manageable levels but ultimately it will be incumbent on governing bodies to regulate or legislate the provision of service information on this basis to protect their effectiveness to affect markets in the event of imbalance.

TfL and CityMapper:

Transport for London has some real successes in sharing data. They published 200 types of data³³ for open access, along with thousands of threads of meta in order to foster collaborative use of data for the benefit of the city of London. TfL's head of digital services cites anywhere between 30 and 116 million in benefits³³, a wide range but they've also cited the generation of 1000 associated jobs³³.

The real success though is CityMapper. Citymapper was a business entirely reliant on open access APIs mostly afforded by TfL. They've developed complementary systems and have now taken their benefit to deliver a new iDRT Smartbus system³⁴. In order to fulfil the public value balance Citymapper reciprocate the data used back to TfL on an open basis to further augment the data offering. The sharing of information has led to a symbiotic ecosystem that provides clear public and private benefit and continues to illustrate the well established benefit of reciprocal data sharing in transport systems.

More recently Citymapper has launched a MaaS service³⁵, focussing on TfL PT services and itsbikeshare scheme. If Citymapper continues this reciprocal arrangement through its more revenue-targeting strategy, it could be considered to be a continued example of success in data and information sharing. If it should choose to depart from this relationship however, strong regulation may be required³⁶.

1000

associated jobs generated by Transport for London. ³³

200

types of data published for open access. ³³

INCOMPLETE MARKETS

Missing or incomplete markets exist where there is an inability for established market forces to adequately balance the flow of value between parties. An example of this is the potential for pure or ‘quasi-public good’ value capture by MaaS providers and TSPs. Public transportation and transport infrastructure in many jurisdictions are publicly resourced assets, with investment and subsidies for delivering infrastructure and services being often publicly sourced.

In simpler times past, revenues for public infrastructure use such as PT revenues have flowed back to a public purse, therefore providing a proportion of return for this investment in a relatively direct manner. However, with a move towards a much more disaggregated service model, and MaaS providers and TSPs playing a wider role, there exists a risk that value is captured from publicly-supported assets in order to derive unbalanced private profitability. If government agencies are ill-equipped to adequately recover sufficient proceeds to fund the upkeep and maintenance of the transport system from which the private providers gain profit, then the public-private value balance sheet will be disproportionately assigning value to the private sector.

There is an equilibrium to be struck between optimising utility of public infrastructure, the provision of additional public transport, and the off-balance sheet satiation of demand by private TSPs. In theory this is necessary to not only maximise economic utility but to support a fiscally sustainable transport system, providing relief to central funding budgets while ensuring that user demands are met. The move towards a MaaS ecosystem has the ability to increase government spending power through an increase in off-balance sheet investment. However, when we look at how this balance can be practically achieved, it is not quite so simple.

TSP capital investment at start-up is typically low. By way of example, Uber’s fixed costs are very low on a per trip kilometre basis and other transport service providers such as Lime are small at best, this creates a low contribution margin³⁷. As such investors tend to assess the contribution margin of these service providers to establish whether they are a well performing prospect. When compared to the typically multi-billion dollar investment required for mass transit heavy rail, and the subsequent yield on cost per kilometre travelled (c.€0.10 - €0.15 in the UK France and Germany, €0.10 in Finland and Denmark and as little as €0.06 in Italy³⁸) it is clear that the flexibility to deliver services on an individual basis via TSPs is offset by a need to move large volumes of users via highly expensive but efficient mass public transport systems. Public transport’s reduced yield per passenger kilometre means that for real savings to be realised through patronage reductions and transfer to other transport service providers, there must be large modal shifts on a complete service basis.

By way of example, a hypothetically provided train service could need a reduction in 2000 passengers per hour before the public operator could stop the service, stop incurring the operating costs and write off the capital expenditure associated. However, if just 1990 passengers transfer to another form of transport, this would lead to the same fixed and operating costs being required for just 10 people; if that is the single mode that meets their needs. This scenario is most typically applicable to those with greater distances to travel, and such users are unlikely to use urban-mobility services on more than a first and last mile basis. When these savings are realised, they are great, but they are accrued on an irregular and disproportional basis. We must understand and account for such differences in business models when working to maximise public value.

Regulatory costs such as licensing, wage minimums and utilisation rates are considered to be a margin cost per trip, this can directly affect the contribution rate of TSPs and MaaS providers and as such the applicability and allocation of these costs need to be considered very carefully. Exclusion of use from public infrastructure such as the road network is not feasible, and all applicable forms of direct-regulation must be considered to adequately match enforcement strength to flexibility of terms as the city mobility system evolves. Governments must ensure that they are matching the correct level of regulation to the needs of the city while being cognisant to not unduly fetter private sector innovation and undermine public value as a result. Government must also be highly conscious to not broad-brush apply TSP-related regulation to MaaS providers and vice versa. We will discuss some appropriate forms of regulation in more detail later in this document.

When compared to the typically multi-billion dollar investment required for mass transit heavy rail, and the subsequent yield on cost per kilometre travelled it is clear that the flexibility to deliver services on an individual basis via TSPs is offset by a need to move large volumes of users via highly expensive but efficient mass public transport systems.



MISSING MARKETS

The market failure phenomenon of missing markets relates to a situation where a critical part of the overall demand system cannot be supplied on an economical basis. In mobility terms there is a wish and need for a particular service but in the current conditions it is unable to be provided. In most cases this requires a considerable market intervention to limit the development of a skewed or unbalanced system or the city will respond organically to serve the gaps, often to the indirect ultimate detriment of public value. Although MaaS is not considered to be a solution or cause in such a missing market case, it has the opportunity to both make a good system better, but also

make a poorly serviced system much worse—through convenient, fast and easy access to alternative services which through no-fault of the MaaS provider or TSPs are detrimental to the ultimate long-term public good. In such instances, government collaboration and intervention may be necessary to support the city, in order to right the imbalances at the heart of the system. If the fundamental bones of the transport infrastructure are flawed, MaaS will be unable to solve this, more likely providing an accelerated exacerbation of the existing issues.

“The subway system is no doubt in distress and we’re here for solutions” ³⁹

Joseph Lhota, NYC MTA Chairman, June 2017



New York City

The January 2018 ‘Fix NYC Advisory Panel Report³⁹’ outlines the daily transportation crises that are experienced by New Yorkers, ‘one above ground, and one below’. Road congestion and use are one aspect of the overall mobility biopsy. The subway system has experienced similarly poor levels of service for many years due to failing investment, poor management and political mistreatment. Unfortunately for the ‘one below’, the subway has been focussed and pinned up as a representative scapegoat for all of NYC’s transportation woes. This is to some extent valid. The failing subway system drives customers back ‘top-side’ into the arms of the waiting ground-transport system, further stressing the already at-capacity road network. Taxi ranks are effectively acting as car parks, newly provided ridesharing services must deadhead through the system rather than occupy taxi ranks and as the town-car became a viable alternative to the lower-quality taxi and ‘UberX’, it eventually became an aspirational social status symbol for many professional citizens of the Manhattan working demographic.

The issue is one of traditionally missing markets, a missing alternative to the road network and, given the significant lack of space for further service or capacity development, a lack of ability to provide a physical solution outside the existing systems. Further exacerbating the land-use pressures are the over-flowing pedestrian sidewalks, littered with services obstacles and causing, through sheer volume, pedestrians to spill over into bicycle lanes and other amelioration infrastructure. In Midtown alone between 2009 and 2015 the number of pedestrians has increased by 18% on weekdays³⁹ and a staggering 31% on weekends. Indeed, NYC has not been short of attempting new physical solutions to its issues with 23 pedestrian plazas, 17 bus lanes and 109 miles of bike lanes within or servicing part the CBD³⁹. The MTA has a great deal of work ahead of it, and it is not shying away from this challenge.

We cannot be definitive of course without much more targeted research but taking the current NYC scenario, our conceptual hypothecations and an understanding of transport economics lead us to believe that without a viable mass public transportation system, the effects on the transport system and public value arising from the introduction of a convenient aggregating platform providing access to more private TSPs on the roads and pathways could be significant. The effects of such moves are evident from the introduction of Uber and other ride-hailing services in NYC⁴⁰. The non-PT services provided could be of higher quality than direct PT, but may lead to an exacerbation of the transport issues of congestion and in turn stymie PT investment through low usage. This would create an ever-unvirtuous cycle leading to an ultimately worse off city that continues to grow daily. Pedestrians will be forced from more-crowded sidewalks into and onto reasonably-priced MaaS solutions, most notably cannibalising the base form of transport – walking. This will relieve sidewalks temporarily but undermine active transport health benefits while putting further pressure on roads due to the inadequacy of alternative subway systems.

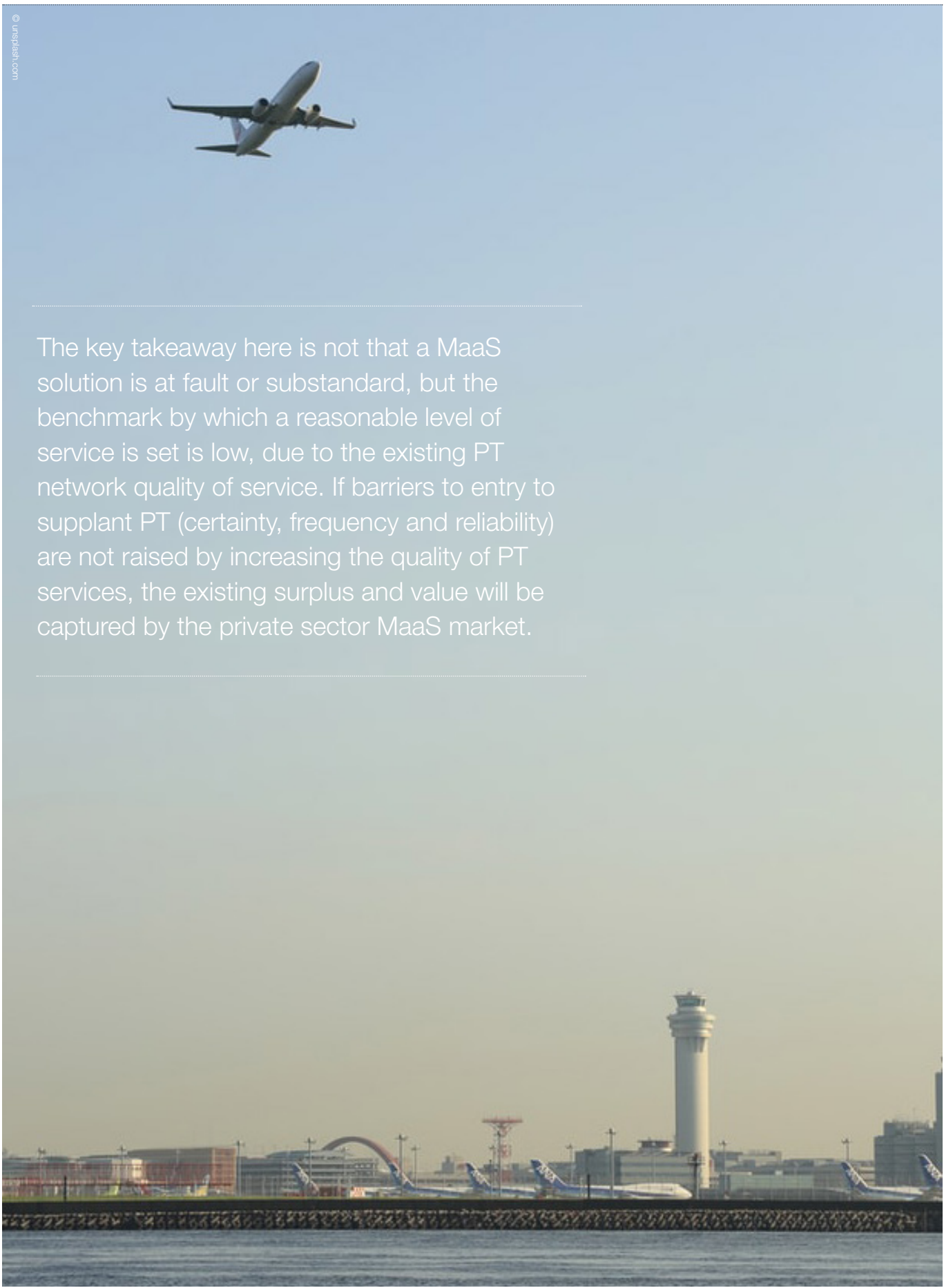
31%

increase in
pedestrians
on a weekend. ³⁹



MaaS is not in itself a good or bad solution for NYC, it is debateable if it is a solution at all, but it is an evolution in the transport ecosystem—an evolution that could lead to a solution. It will however lay further bare the plethora of issues faced by the NYC transport system. If not carefully governed within the wider spectrum of initiatives from PT upgrades to Road User/Congestion Charging it will lead to an accelerated failure of the system as a whole.

The challenges faced are greater than MaaS alone, and as such any solution considering MaaS should consider the whole mobility ecosystem accordingly. The integration of a viable PT service within a future MaaS platform will be critical to avoid the permanent undermining of the relationship between private TSPs, MaaS platform providers and the city.



The key takeaway here is not that a MaaS solution is at fault or substandard, but the benchmark by which a reasonable level of service is set is low, due to the existing PT network quality of service. If barriers to entry to supplant PT (certainty, frequency and reliability) are not raised by increasing the quality of PT services, the existing surplus and value will be captured by the private sector MaaS market.

THE FUTURE OF MOBILITY AND MAAS

Government Transport Revenue and Expenditure

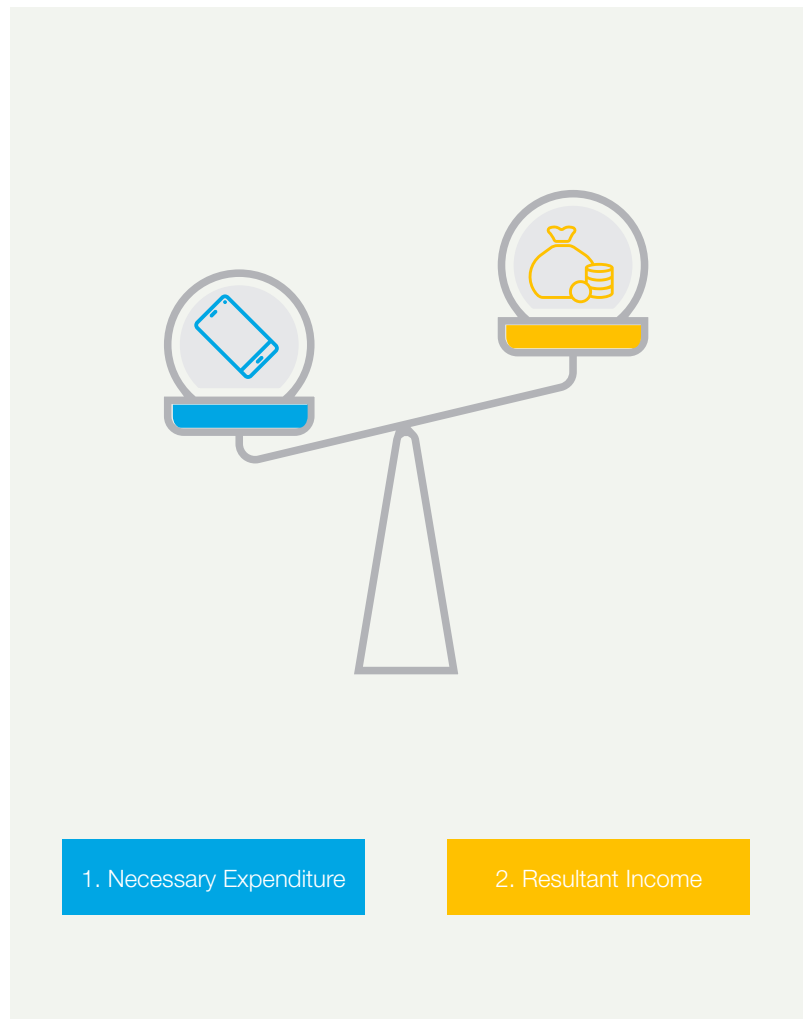
Government income is composed of many complex elements. To support a balanced PT and TSP mobility system, with a vibrant MaaS ecosystem overlay, we must ensure that disproportionate costs to income do not exist on the public or private side of the market.

If public costs increase disproportionate to levels of related income, either directly through fare revenue or indirectly through transaction or corporate taxes, then this balance will be threatened.

MaaS has the ability to accelerate the use of both public and private transport, purporting to increase convenience and access in each case. It should be considered therefore that MaaS providers become part of the overall balance in revenue and expenditure, the flow of cost and income between TSPs, the Public Sector, MaaS providers and Users. The monetary ecosystem and balance is incredibly complex and must be thought of in complexity rather than simplicity to ensure that public value is not siphoned off through a myriad of private sources or public sector bureaucracy.

Alternative forms of transport must be offered in order to maximise level of service but the promotion and management of supply and demand related to this service must be carefully considered. Promotion of Public transport services for example comes at public cost, but promotion of fiscally efficient private transport services must be monitored to maintain a public value-optimal equilibrium. Both of these options exist in a post-MaaS environment and as such, the coordination and collaboration between MaaS providers, governments and private TSPs in our urban areas will be critical to ensure an economical, equitable and efficient allocation of cost and revenue is achieved in the market. Optimising the balance between public and private income and expenditure is critical in maximising public value and this should be the primary focus of government in all revenue and expenditure discussions.

Governments must be cognisant of the impacts to tax and revenue but more importantly the overall net balance of facilitating, adopting and orchestrating a shift towards an integrated MaaS ecosystem between PT and private TSPs. This should include the potential release of capital and potential increased spending power through a move to usership.





THE FUTURE OF MOBILITY AND MAAS

Qualitatively Assessing Potential Mode Impacts

From consultation with government representatives in Australia and Ireland, our workshops identified that adverse behavioural change in users was a key risk item for transport authorities. It was noted that, supportive and often derivative of market instability, and through direct or inadvertent means, Mobility as a Service could radically change the behaviours of users. The effects could be both positive and negative. Actions by private providers to incentivise profitable but network-damaging services could lead to behaviour change from users and undermine the necessary viability of mass transport in urban areas.

Based on Arup's extensive experience in transport infrastructure planning, design and delivery we committed to identifying some of these impacts on a qualitative basis, with a future collaborative commitment to quantitatively research their effects further. Building upon the MaRS and Arup Greater Toronto Area MaaS Value report⁴¹ we categorised the modal changes by trip type and source of trip (MaaS based or direct).

MODE IMPACT TYPE	POTENTIAL IMPACTS	
Vehicle trips to MaaS based PT	- Increases fare revenue, increases utility of subsidy, decreases congestion, potential requirement for additional public investment on Opex or Capex based on PT utility threshold.	✓
Vehicle trips to MaaS based non-PT (single occupancy)	- Increased VKT, increased congestion, decreased sunk private cost, increased private patronage, public transport opportunity loss, reduced vehicle tax related revenues.	?
Vehicle trips to MaaS based non-PT (pooled and multiple occupancy)	- Increased transport system utility, slightly reduced congestion, decreased sunk private cost, slightly reduced VKT, public transport opportunity loss.	✓
Induced non- PT MaaS based trips	- Increased VKT, increased congestion, increased private utility to the point of capacity, potential capacity issues, increased investment required, potential introduced health impacts, potential additional environmental impacts.	✗
Active trips replaced by vehicle MaaS based trips	- Increased VKT, increased congestion, health impacts, environmental impacts, potential capacity issues, potential investment requirement, potential increased tax income, potential public transport opportunity loss.	✗
Induced PT trips via MaaS	- Increased utility to point of capacity, potential increased investment requirement, increased fare PT revenue, potential increased congestion, increased VKT, increased environmental impacts (dependent on utility and capacity).	✗
PT replaced by other MaaS service (single occupancy)	- Decreased public transport utility, increased VKT, increased congestion, increased environmental impacts, reduced public transport revenue, reduced public transport subsistence, reduced public transport utility.	⚠
PT replaced by other MaaS service (pooled and multiple occupancy)	- Decreased public transport utility, increased VKT, increased congestion, increased environmental impacts, reduced public transport revenue, reduced public transport subsistence, reduced public transport utility.	?

THE FUTURE OF MOBILITY AND MAAS

Insurance and Consumer Protection

In the motoring industry, insurance is the backbone of 3rd party protection and ensures that in the event of an incident, all parties have a semblance of coverage – regardless of blame. Legal mandating of many forms of insurance ensures that coverage is relatively total.

In contrast, where insurance coverage is not mandated it can lead to disproportionate value being lost between those who act without insurance and those that opt for insurance.

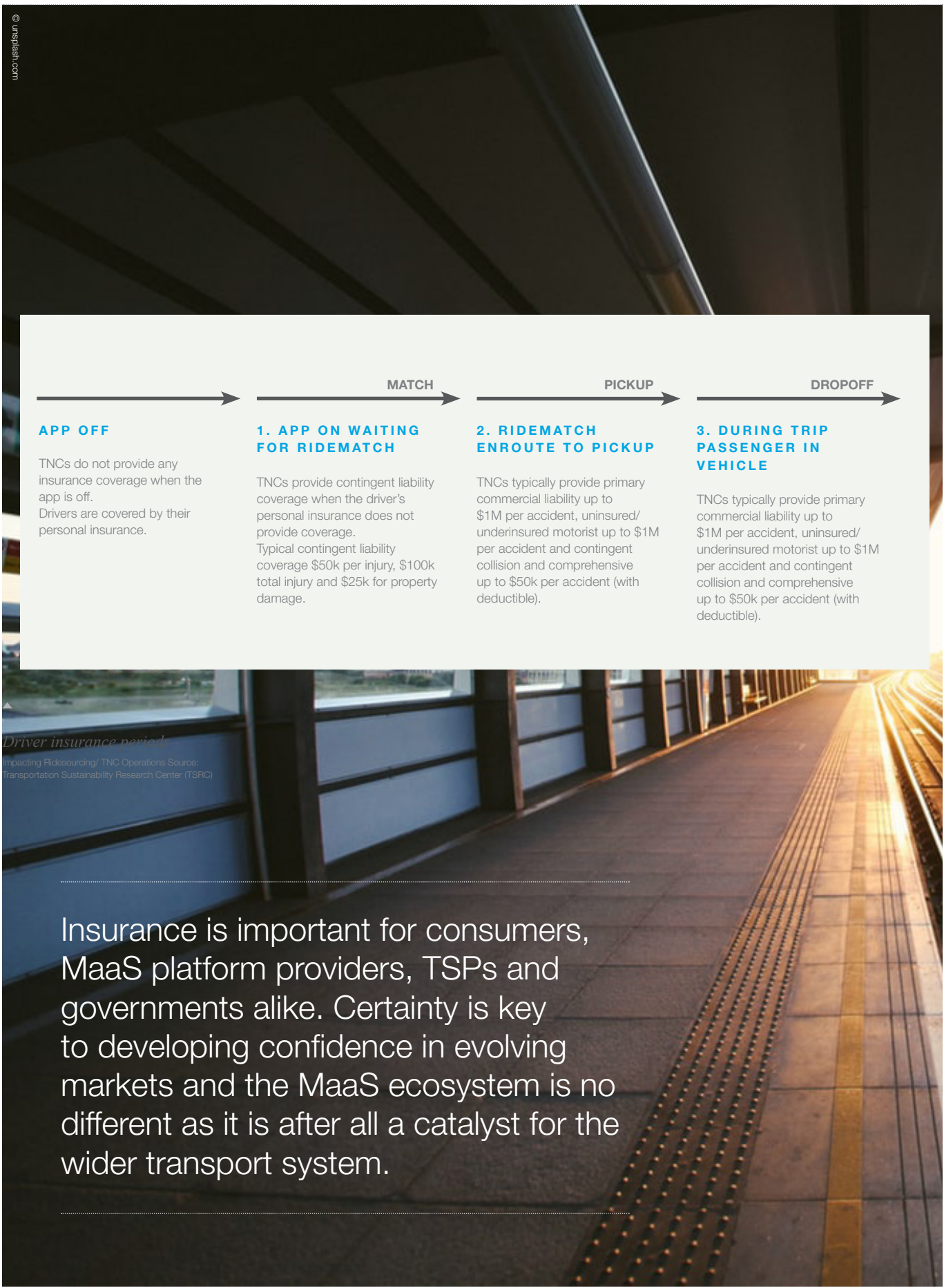
The purpose of insurance in the MaaS ecosystem and context is unlikely to change, however along with many other industries, insurance mechanisms are undergoing significant disruption. To this end we will look to see how some of the developments in the transport, shared mobility and MaaS industries are being approached by the insurance products industry. Insurance is a very wide-ranging industry, with representations in many different MaaS-related sectors. Key insurance industries we will focus on will be:

- Vehicle and Motor Insurance
- Public Liability and Personal Injury Insurance
- Health Insurance

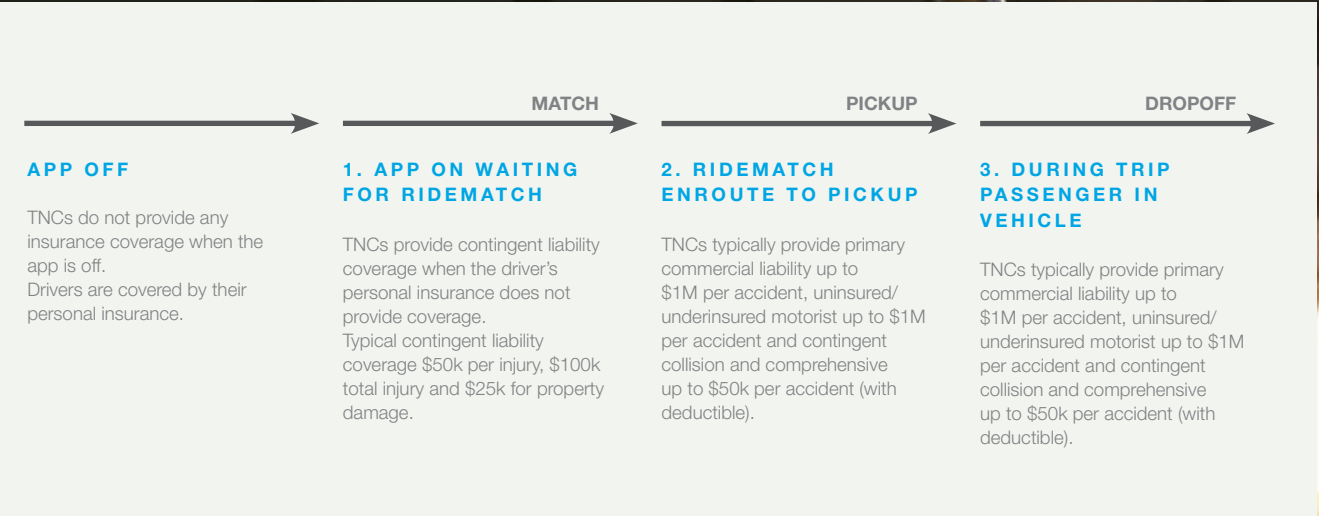
There will likely be many more insurance sub-types affected but for the purposes of this report we will limit our consideration to these.

RIDESHARING INSURANCES

Many MaaS related TSPs operate on the basis of zero or intermittent hourly contracts for their workers. Services such as Lyft, GoGet and Uber operate on a purely application use basis. When an application is being used, the TSP provides its sub-service providers with varying levels of coverage based upon their activity. This is primarily to ensure that no gap exists between private insurance coverage (limited to the period during which business activities are not being undertaken) and commercial business insurance – that which is provided to cover an employee or service provider in the act of providing said service. In the rapidly changing ‘gig-economy’ the switch from personal to commercial use and back to personal use can be relatively rapid and insurance products have had to adapt accordingly. The USDoT Transportation Sustainability Research Centre^{32, 42} aptly summarised the complexities in coverage for ‘ride-matching’ TSPs in the graphic included right.³²



© unsplash.com



Driver insurance period
Impacting Ridesourcing/ TNC Operations Source:
Transportation Sustainability Research Center (TSRC)

Insurance is important for consumers, MaaS platform providers, TSPs and governments alike. Certainty is key to developing confidence in evolving markets and the MaaS ecosystem is no different as it is after all a catalyst for the wider transport system.

Ridesharing activities are a specific transport mode and insurance must be tailored accordingly. No longer can overarching insurance products adequately and efficiently cover the changing business activity profile of TSPs. Governments must therefore ensure that adequate legislation is in place to enable insurance regulators to monitor the coverage of insurance across the overall MaaS market. What must be defined in each insurance case is the assignment of responsibility for providing operational insurance between consumer, TSP and MaaS provider.

For the purpose of the fulfilment of operations, this responsibility must fall upon the TSP (whether public or private). The application of this operational coverage can either be broad brushed (potentially at a premium) or applied specifically during the period of TSP operations (more efficiently but complexly). Government should therefore legislate that all TSPs have adequate commercial insurance coverage for their activities during operations. The basis of this legislation should be collaboratively developed with insurance experts and industry providers. This should be in addition to, but potentially combined with, a need for Public Liability insurance and clarity with respect to vicarious liability.

In the United States, Oregon House Bill 3149 (HB3149:2011)⁴³ was followed by Washington House Bill 2834 (HB2384:2012)⁴⁴ and sought to establish standards for ‘personal vehicle sharing’. Both built upon previous political establishments by California Assembly Bill 1871 (AB1871:2010)⁴⁵ to allow and define personal vehicle sharing in the state of California and mandate the provision of insurance products accordingly.

These bills laid the foundations for passing standards in key urban jurisdictions and removed barriers to personal vehicle-sharing, a key component to the success of MaaS in the movement from ownership to usership of private vehicles. Such examples should be considered good initial practice for other jurisdictions looking to address challenges associated with consumer protection in the future MaaS and TSP ecosystem.

VICARIOUS LIABILITIES

Vicarious liability, as the name suggests, is liability assigned to another party by virtue of them claiming resultant benefit from their actions or services rendered. In the context of employment, vicarious liability can be considered to be liability assigned to an employer for the acts of an employee during their course of employment. Vicarious liability may also be applicable where it is deemed that someone other than the person who caused the injury (physical or otherwise) is deemed to have control, direction or ownership of the situation.

In the context of MaaS and TSPs, in particular the move towards shared mobility, this is especially interesting, dangerous, convoluted and complex. Scope of employment, contractual basis of employ and acts of an illegal nature all cast further complexity on the placement of liability in the case of incidents. Often it is beholden to the justice system to cast judgements in the cases of unclear guidance, and it is for this reason that we highlight vicarious liability complexity as a risk to public value.

\$1bn

in rental car costs to consumers every year due to vicarious liability.⁴⁶

The legislation noted, in Oregon, Washington and California has support in much part due to the economic benefit it affords, but also due to a little recognised addition that extracts liability for car-share operators based upon a somewhat divisive law passed in 2005, the Graves Amendment⁴⁶. Prior to 2005, laws such as the New York Vehicle and Traffic Law § 38847 and the NSW Motor Accidents Compensation Act⁴⁸ could create vicarious liability for damages to vehicle owners for the negligence of the drivers, including those they may have leased unto.

In the United States in 2005, the Republican representative for Missouri Sam Graves proposed an amendment to insurance legislation to remove vicarious liability for rental vehicle companies that, Graves indicated, was costing consumers

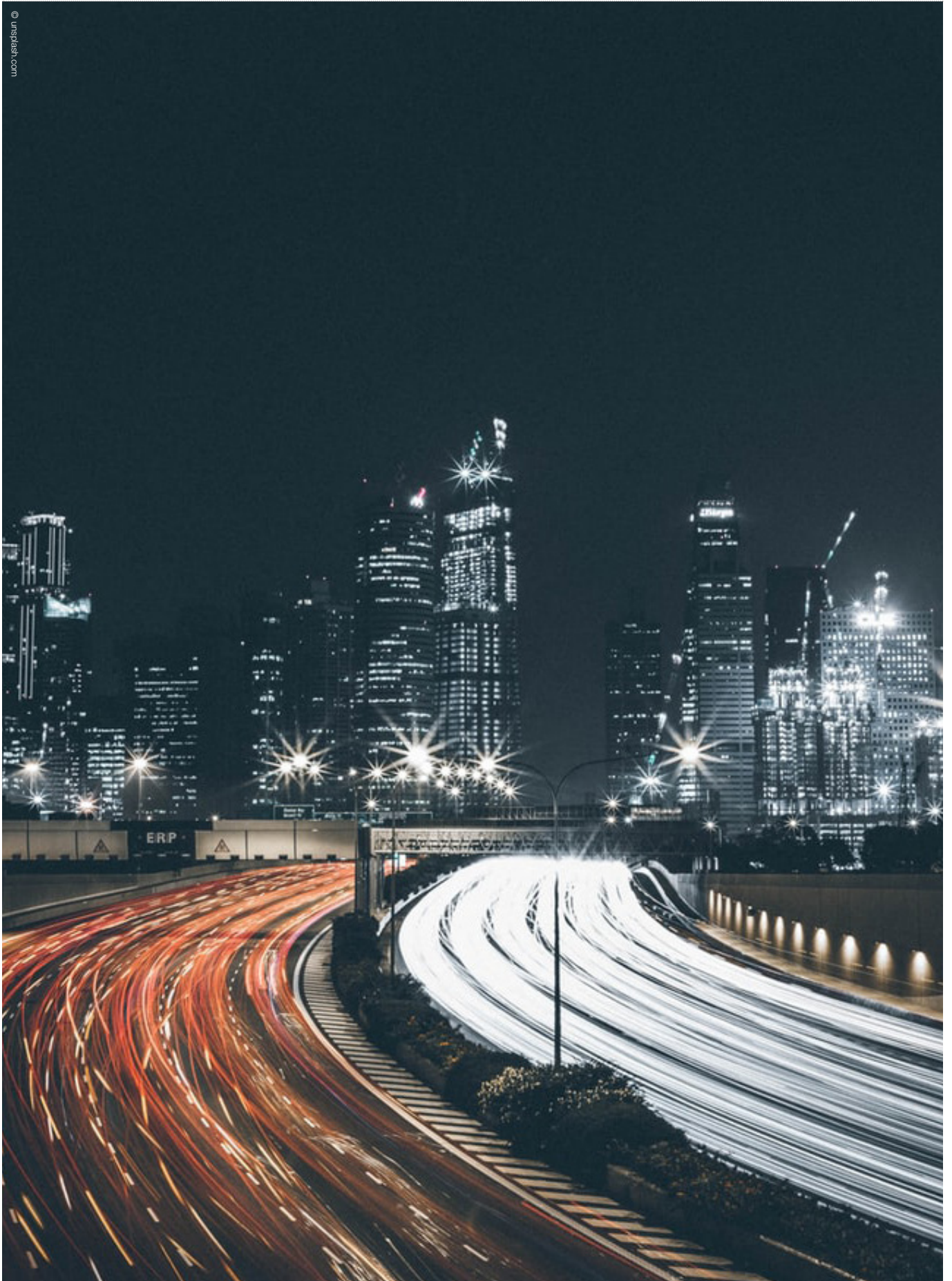
\$100,000,000⁴⁶ in rental car costs every year. Prior to the Graves Amendment, damages for accidents and injuries could be sought from both the fault driver's insurance and the rental company from which the vehicle had been leased. Limits on entitlement in major states such as New York and California were not limited, and this led to what was considered to be excessively high settlements in a number of cases.

Such legal conjecture, disparity and ambiguity cannot serve to support the public good. In cases of good governance, legislatures should look to provide clarity of responsibility for MaaS providers and TSPs in providing their services and engage frequently with lawmakers and insurers to ensure adequate protection for both consumers and companies alike.

CASE STUDY: RUBY VS BUDGET RENT-A-CAR

A case referred to when discussing the Graves Amendment in New York, is the Ruby vs Budget Rent-a-Car case, a case brought by Kreindler & Kreindler LLP on the basis of New York Vehicle and Traffic Law § 388 in 2000. The case notes state that 'On November 29, 2000, 25-year-old Ethan Ruby was walking across the cross-walk across Delancey Street at Orchard Street on the lower east side of Manhattan, when the driver of a Budget Rent-a-Car ran a red light and caused a collision which left him paralyzed. Ethan had been a Division 1 baseball player at the University of Pennsylvania and had moved to New York upon graduation in 1997 to form a successful Wall Street trading firm'. Kreindler argued that Budget was liable for the negligence of the driver whom it had rented the accident vehicle. Budget Rent-a-Car conceded liability pre-trial and ultimately entered a damages judgement of c.\$20 million (subject to various amendments post-trial).

Governments should proactively engage with specialist stakeholders and look to define the levels at which cover, protection and residual liability sit throughout the MaaS ecosystem.



GOVERNMENT ENDORSEMENT

In order to afford legitimacy and confidence in a process or service, government can opt to provide the services outright or endorse the provision of the services to users. Endorsement is considered to be an increased commitment to that of licensing, as it includes a level of reputational (or legal) guarantee of a specified level of service to customers on behalf of a private entity. This clearly has a number of risks for government in an emerging mobility and MaaS market, where service offerings may still be nascent.

Focussing on MaaS, if a government endorses a MaaS provider or operator, anything on the platform it provides is backed by government consumer protection guarantees. In some jurisdictions this includes government deposit protection and escrow laws. Furthermore, TSPs represented on that platform are vicariously endorsed, leading to a guarantee of service at the platform and service levels.

Service level agreements with key performance indicators (KPIs) are required to monitor and guarantee the effective delivery of services to customers. Such contractual obligations require real time information and data to ensure services are upheld within threshold levels. TSPs should be stringently regulated to operate only within those areas of service they can guarantee, potentially via licensing. However, there cannot be regulation at TSP level alone, if the government is endorsing the platform as a whole. In such a case, one may consider a term of use or conditions structure with platform providers to provide sufficient flexibility for innovation but to uphold a minimum level of service. This can include additional obligations such as data sharing and adherence to local data by-laws.

Endorsement is complex, and governments must consider undertaking this action for its costs against the ultimate benefit to public value, often in the face of considerable commercial pressure.

DATA PRIVACY AND GDPR

Technology and data have become the great enabler for the fourth industrial revolution and the emergence of the truly digital economy. The traditional approach to what it is to be human, is now being challenged mainly by the interconnectivity, the increasing number and capabilities of algorithms making decisions, the exponential use of digital technologies, and the amount of data being collected. As we continually strive to develop new ways to elevate the prosperity of our societies and create new ways to achieve our mobility needs more efficiently and conveniently we are generating exponentially more data. With this creation of ever more data comes evermore opportunity, but with it also comes risk, risks associated with privacy, security and ethics in particular.

To achieve the aims of creating a more seamless, integrated and convenient mobility experience for consumers, MaaS providers and TSPs will be generating, processing and handling large quantities of data on behalf of users. The importance of sharing and open data is consistently referenced as a key factor to ensuring the upholding of public value within our future mobility ecosystems and society. Such open data itself must be very carefully managed and governments must ensure that guidelines and regulations for the sharing, processing and handling of user data are clearly and concisely communicated to parties involved in data management and exchange. Oversight is critical, and regulations such as the European General Data Protection Regulations (GDPR) form a solid foundation for the expectations for data use, processing and handling by all parties.

Given the fundamental importance of data in enabling the digital revolution that MaaS is constructed upon, adherence to data regulations such as the GDPR are necessary for the ultimate protection of public value.



PURCHASE, DEPOSIT AND PAYMENT PROTECTION

Deposit protection schemes are common in real estate markets, providing government backed guarantees to tenant provided liquidity. Applied to a micro-mobility context, we have seen some cracks emerging in the provision of deposits for bikeshare schemes-which in turn is used by failing businesses to fund operations. The issue for bikeshare schemes is one of capital and liquidity, having limited access to funding to invest in high-numbers of relatively low-value assets. Compounding this, costs for maintenance are high, and per-trip returns are very small. In 2017, China saw a vast wave of bankruptcies in the bikeshare sector and with it the loss of millions of dollars of customer deposits⁴⁹.

Despite regulatory frameworks stipulating deposits not be used as operating capital, loopholes were exploited in reporting to hide this practice-for a time. As can be seen in Figure 2⁵⁰, Shanghai alone has 450,000 shared bikes across all its schemes and noted in 2017 that it had around 2.5million yellow bikes across 43 cities⁵¹. Beijing based Kuqi filed for bankruptcy and left its 16million users without access to their 45\$ deposits⁴⁹. Although it is unclear how many of the users had paid a deposit, this clearly represents hundreds of millions of dollars of public cash that is potentially at risk.

If the Chinese government had endorsed Kuqi as a mobility solution, or if it had endorsed a MaaS platform that provided Kuqi would this mean that the government would have to underwrite the deposits afforded to customers in addition to bankruptcy proceedings?

It is unclear. However, what is clear is that governments have moved to outlaw the use of deposits for operational capital, ensuring that reporting clearly delineates between customer deposits and budgets, and storing of deposits in individual merchant bank accounts. In China, the Ministry of Transport issued document No. 109 [2017]⁵² encouraging and Regulating the Development of Internet Bicycle Rental.

Such legislation is an illustration of the level of consideration required for such mobility initiatives but also illustrates the potential impacts of new mobility offerings on an unregulated market. Although enforcement appears to have been minimal and ineffectual, many Chinese cities have banned the deployment of further sharebikes. In an effort to retrospectively improve enforcement, some cities such as Shanghai now require individual license plates for each bike. With many sharebike providers now filing for bankruptcy, what will remain to be seen is whether this regulation protects public values, and provides certainty of cash security, or whether it proves to be no more a deterrent than no-regulation at all.

450k

shared bikes across all Shanghai's schemes.⁵⁰

2.5m

yellow bikes across 43 cities in 2017 in China.⁵¹



NUMBER OF SHARED BICYCLES BY CITY AND BIKE-SHARING COMPANY ('000)

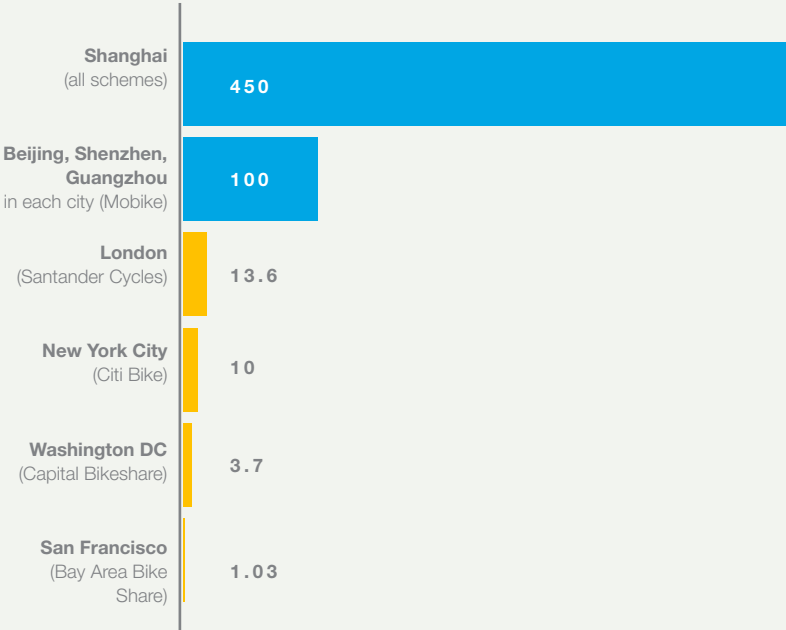


FIGURE 2
China's cities lead the world in bike-sharing schemes⁵⁰

Sources: Shanghai Municipal Communist Party Committee; companies named above; SPIN

THE FUTURE OF MOBILITY AND MAAS

Regulation and Licensing

Regulation and licensing are pillars of control that government has to guide and manage service outcomes within their jurisdiction.

Regulation is incredibly complex, and varies from sector to geography, from jurisdiction to technology and each case must consider the needs of the public with the requirements of a sustainable market in order to maximise the regulatory efficiency of a city, industry, or state. In future research works we will consider regulation in more depth, but we wish to discuss a number of key concepts and challenges that government face in the coming MaaS ecosystem and the wider mobility future.

LEGITIMACY

We started this paper with a discussion of Mark H Moore's Strategic Triangle⁴, noting that one of the three core pillars to success was the presence of Legitimacy and Support for the governing body. Government's protection of public interest is the basis for legitimacy in regulation and licensing. Government is providing that legitimacy to operators by providing market T&Cs or direct licenses. Governments must therefore consider in which sector of their organisations the legitimacy for providing licensing best resides and ensure that this area is supported in upholding the effective issuance, monitoring and management of such licenses, where necessary, having the power to revoke them also.

PUBLIC ORDERING AND REGULATION

Orchestration and public ordering through mechanisms such as regulation can be critical in markets where the interests of the overall public good are not always entirely aligned with that of private enterprise. As indicated within Legitimacy, in instances where government either endorses a MaaS provider platform, or provides access to a form of public transport or publicly funded infrastructure, there must be degrees of regulation. The strength of such regulation and public ordering typically depends on the gulf of difference between the sought outcomes of private enterprise, and the overall goals of the city system.

As noted in Regulation Mechanisms and their Aims, the strength, complexity, flexibility and ultimate enforceability of regulation in the event of non-compliance must be considered in each and every market case. Excessive regulation can create significant barriers to entry, and in the case of private TSPs and MaaS providers can ultimately lead to costs being handed onto consumers and operators—an inefficiency that will ultimately undermine public value. Government's role in aligning the complexity, strength and point of applicability of regulation is critical to achieve the ultimate goal of maximising public value.

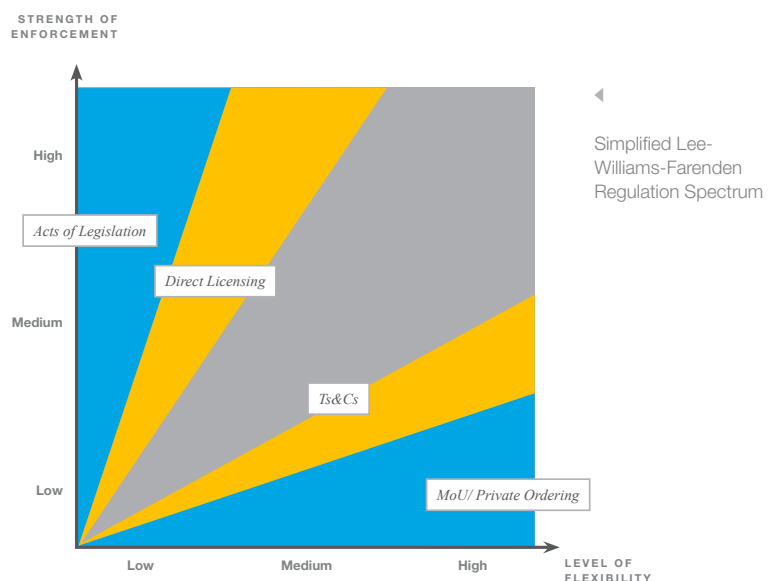
PRIVATE ORDERING

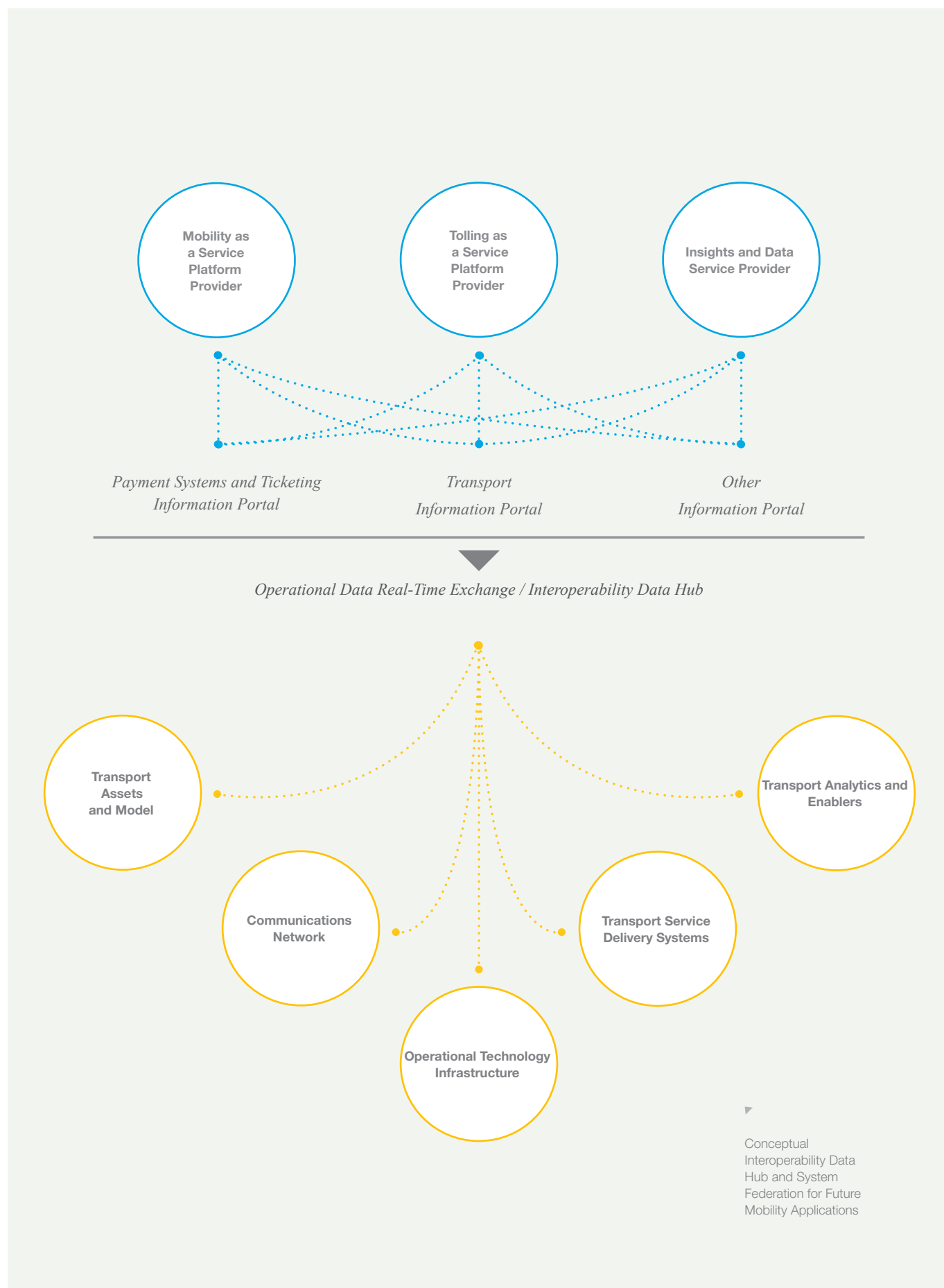
A hot topic in many Corporate Social Responsibility discussions, private ordering is the collaborative activity of policing an industry environment where public regulation may not exist or may not efficiently be employed⁴. Private ordering is effectively a set of understandings within an industry, applied on a company by company basis (such as company by-laws) that dictate how a corporate intends to behave⁵³. In reality the industry landscape is constructed from a full spectrum of mechanisms from laws through to private ordering. Government cannot be the only arbiter of behaviour within an industry and so early conversations should be had with industry stakeholders as to how they will best align the private ordering processes with some of the more structured forms of regulation such as licensing. The greatest risk to private ordering is competition and lack of oversight.

In the emerging mobility and MaaS ecosystem, particularly in transitional periods, socially responsible private ordering will be key in order to ensure that adverse outcomes to society are avoided. How such a responsible private ordering can be fostered however remains a challenge. The use of open data platforms and the sharing of data reduces the risk of over-reliance on private ordering, but even this may require a level of regulation and public ordering to mandate sharing. There is a long history of private ordering failing when markets get hard, and mobility TSPs and even MaaS providers operate in a hyper-competitive market with very low margins. This makes such private ordering in the MaaS and TSP ecosystem particularly vulnerable to failure.

REGULATION MECHANISMS & THEIR AIMS

Applying the array of tools available to government and market participants to construct a sustainable mobility ecosystem should be the aim of regulation. Combining an understanding of regulatory mechanisms, socio-economic drivers and city systems, authorities will increasingly have to broaden their business capabilities to account for the ever increasing myriad of attributing factors. As sectors such as mobility, energy and social services continue to converge, we may see increasing benefit in cross-sector experience and knowledge in considering how to manage market regulation our cities. Terms and Conditions are more flexible, can be adjusted on a case by case basis and can be amended and updated as the environment changes. However licensing, once provided, is very hard to amend but provides certainty of outcome and ecosystem stability.





THE FUTURE OF MOBILITY AND MAAS

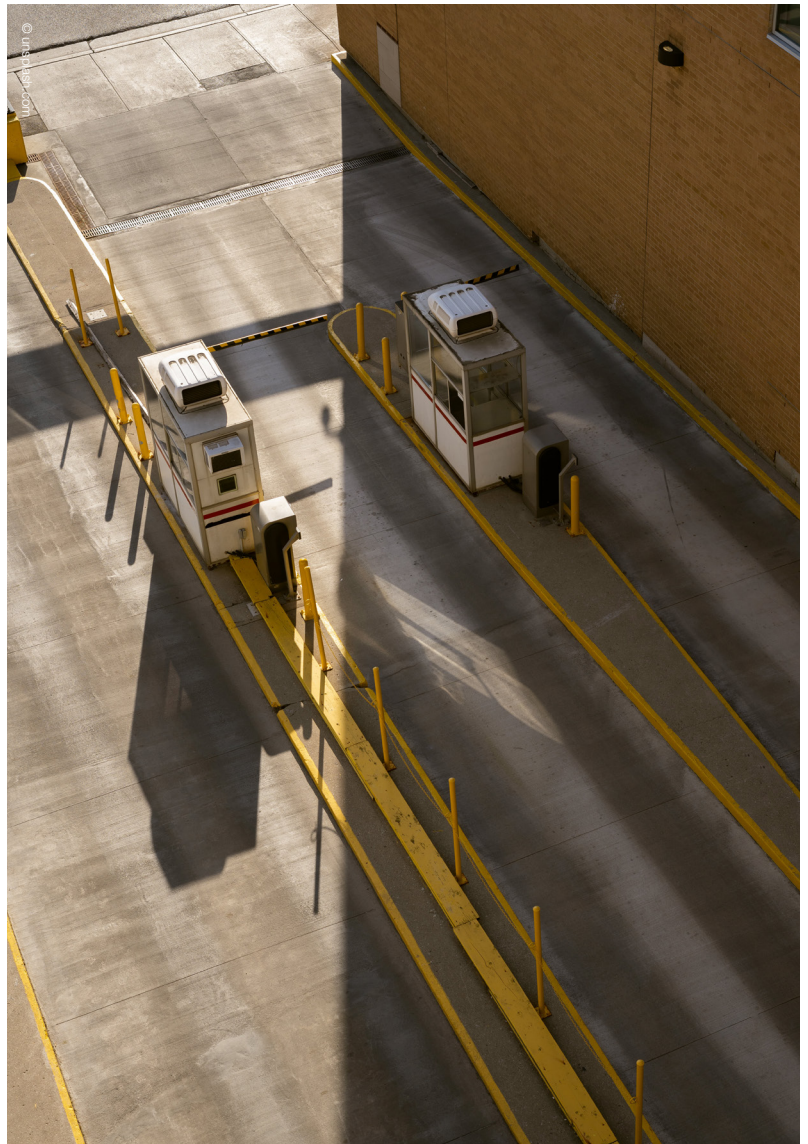
Data Systems and Technology

Much has been discussed with respect to the future of mobility, MaaS and data systems. The role of data and technology is no doubt the means by which much of this change is eminently possible today rather than in times past.

The rapid development in digital technologies and the increased precipitation of these technologies within our every-day lives has led to an expectation from the public of a smarter, more efficient and more sustainable form of mobility. This document does not intend to dwell significantly on the technological considerations of developing a future mobility ecosystem, whether that be MaaS enabled or otherwise. It does however wish to explore a few of the key salient issues presenting challenges to public value, and therein the role of government.

For the purposes of this simplified review we will group 'data forms' into three discrete sets:

- Transport Data
- Fare, Payment and Ticketing Data and
- Other Relevant Data.



TRANSPORT AND TRIP DATA

Transport data can be presented in many forms, and from many sources. However, the most critical forms of data from a transport system perspective are GTFS (R) compatible data, TransXchange or equivalent operational data, SIRI messaging or equivalent data, PT signalling priority data and other timetabling and coordination datasets. When considering the full flow of data from PT operation through to customer as a government stakeholder we must not simply focus on the ‘access to transport APIs’ we must understand the particulars underlying this data. A lack of understanding of the granular level data requirements for both public and private operators could lead to system ‘simplification’ by private entities looking to capture a foothold in the data process.

Such footholds are the cornerstone of data monopolies and can propagate system lock-in risks—one of the primary concerns from consulted stakeholders in both the Irish and NSW governments. Many jurisdictions, NSW⁵⁴ and Ireland⁵⁵ included, have open data portals developed for free access APIs to much of the higher level data necessary to develop supporting applications. Integration, aggregation and presentation of this data on a real-time exchange format is critical for the efficient transfer of information between operational assets and 3rd parties.

A structured approach to open data sharing is necessary to not only maximise the quality and efficiency of data sharing but to ensure regulation and policing of data is possible. Although oft-times suggested as a simple solution to a complex problem, systems integration between public and private operations is incredibly expensive, fraught with risk and complicated. Governments must therefore be able to consider at what point interfacing is more effective than integration, and at these interfaces work internally and with external partners to create efficient and modular federated systems.

PAYMENTS AND TICKETING DATA

Payment systems and ticketing are a very complex area of transportation, and with the emergence of digital applications and Mobility as a Service, these payment systems are becoming even more important. Understanding the intricacies of fare setting, payments and ticket validation is fundamentally necessary to achieve a balance between private sector innovation and upholding minimum levels of service on an economically feasible basis. As with transport data, simplified turnkey solutions to manage payment and ticketing systems are often offered and can represent value for money. However, in many cases, long-term lock-in risks with technology and lack of access to system data can ultimately undermine public value.

In order to avoid technology lock-in, governments should both seek to increase their understanding of the systems they require, but also negotiate contracts for these systems on a performance and level of service basis. This level of service can be more easily developed on a collaborative basis to ensure that constant improvement is built into relationships between transport authorities and system providers, and avoids a transport system being wedded to any particular one-technology.

Australian government stakeholders reflected that this was considered to be a key lesson learnt from past practices and was highlighted within the workshops as a significant legacy cost to the state.





THE FUTURE OF MOBILITY AND MAAS

Governance and Orchestration - *Summary*

This research aimed to look at the future of mobility and MaaS from a perspective of society, to look not only at the challenges to enabling a MaaS ecosystem but the potential direct and indirect effects on the wider transport system and city.

Many items considered or highlighted are not only applicable to MaaS, but are applicable to many emerging forms of mobility. All however should be considered by government in order to maximise public value.

The key takeaway for this research is to encourage government and city representatives to continue to ask ‘Why?’ Why should we support this and how does this mobility initiative support the betterment of public value? Much has been considered on how to achieve a future of mobility, but we must continue to strive for a publicly beneficial mobility ecosystem.

Some of the summary considerations are as follows:

FOCUS ON MAXIMISING PUBLIC VALUE

Every decision has consideration points, positives and negatives, costs and benefits. Government bodies must ensure that they uphold the collective integrity of societal public value and ask the necessary questions of those who would seek to enter into a market utilising public assets. Engagement must be collaborative and constructive but ultimate governments’ aims must be to maximise public value.





RESPONSIBILITY AND LEGITIMACY

Government must focus on what it can, and reasonably should, positively affect. This is very hard to define but where government can establish its legitimacy, and feels it has a responsibility to uphold public value interests it should ensure it holds a position from which to act. Early collaboration with market partners and transportation stakeholders is critical to ensure that the roles and responsibilities of government and private partners are clearly understood from the outset. Where legitimacy is assigned to partners by way of licensing, the responsibility of government becomes to ensure that this license is operated according to the government's assigned responsibility.

BALANCE IS CRITICAL

Balance is reflected through all aspects of this research. Balance between public and private transport expenditure. Balance between regulation and private ordering regimes. Balance between private TSPs and public mass transit. The future MaaS ecosystem must be constructed to enable this balance and ensure that a balanced system optimises public value.

INTELLIGENT PROTECTION AND SMART REGULATION

Enforcement of regulation and application of rigid legislation comes at cost, and the collective impact of establishing regulation should be weighed against the ultimate net public value benefit. Regulation and protection must be contextually relevant, applicable to the particular responsibility of government and established where government has a bona-fide legitimacy to regulate.

In order to establish this remit of responsibility, government should collaboratively identify the key areas of risk to public value and construct regulations and protections on an efficient and tailored basis focussed upon limiting the negative impacts of these risks. Where risk to public value is considered lower, the flexibility of protection and regulation should be adjusted accordingly.

PROACTIVE ENGAGEMENT AND CONSULTATION

Governments must ensure they engage early with other public agencies and market partners early in order to prepare themselves for the commercial and social pressures of the future mobility ecosystem. Rather than reacting to enquiries and recommendations from the private sector, governments should ensure that they are suitably prepared, capable and legitimately able to act in the best interest of public value. Such practices transcend MaaS and transport, but are the fundamental basis for effective stewardship of our cities and society.

SOCIAL STEWARDSHIP AND CONSUMER PROTECTION

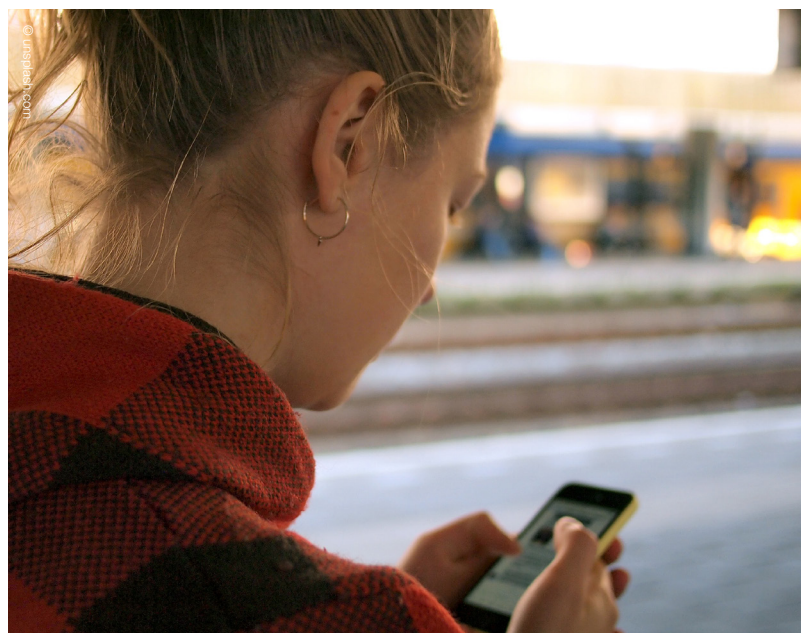
We must all consider the ultimate public value benefit of the actions we undertake when considering the governance and orchestration of the future of mobility and MaaS. Focussing on those most adversely affected, at risk and marginalised by potential change is critical. Metrics and assessment for the ultimate benefit of action or inaction must be established to effectively quantify impacts to accessibility and social equity, and such impacts must be considered as important as effects of environmental and economic prosperity.

CONTEXT IS EVERYTHING

We must think of our transport and mobility initiatives, including the move to a Mobility as a Service ecosystem, as city initiatives rather than just isolated transport projects. There is no one-size-fits-all framework for how to regulate, facilitate or protect and optimise public value in all cities and we must therefore bring global lessons to a local context before applying broad-brush public or private solutions. The city organism is far too complex, with too many variable elements, to allow for simplistic and generic responses. City partners and governance stakeholders must engage early with their citizens to establish what is needed for their jurisdictions, what is ultimately in the long-term best interests of the city and how best to make this happen. Be proactive, but don't rush governance responses that do not adequately consider the context in which the response will reside.

FLEXIBLE WHERE POSSIBLE, RIGID WHERE NECESSARY

Terms of reference should be established early between the city and potential mobility partners. Points of critical importance should be identified to denote key areas where flexibility is not possible in the interest of public value. On those points of potential development, match government regulation to the level of understanding, risk and maturity of the particular issue. Where understanding is low but further investigation is needed, consider flexible solutions with piloting. Where risks are high but with proper consideration benefits could be also high, consider a long-term legislative development that restricts unregulated entry but allows for future amendments once understanding and particular needs are established. The tools and mechanisms for regulation are numerous and should reflect the aims and needs of the public.



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