

Stated preference design for mobility as a service (MaaS) broker/aggregator contracts

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Abstract

Mobility as a service (MaaS) promises a bold new future where bundled public transport and shared mobility options (carsharing, ridesharing and bikesharing) will provide consumers with seamless mobility on par with and exceeding that of private vehicle ownership. Whilst there is a growing body of work examining the market and end user demand for MaaS, there remains a limited understanding of the supply-side around new business models for delivering these integrated mobility services. Mobility broker/aggregator models have been proposed, but to date there exists no quantitative evidence to empirically test the conditions around which interested businesses might invest or supply in this new entrepreneurial model. In this paper, we propose the idea of mode-agnostic *mobility contracts* as the interface for bringing together specialised businesses as part of the new MaaS ecosystem. We identify the relevant attributes and attribute levels defining these contracts through an extensive interview and participatory research program with key stakeholders including MaaS operators, conventional transport operators, public transport authorities and consultancies, with a focus in the Nordic countries where such schemes are presently well advanced. These mobility contracts were then incorporated as part of a stated choice survey, and we document the face-to-face pilot used to finesse the survey instrument, prior to a main survey with the business community globally to understand what the market is willing to deliver in terms of MaaS and how the future service delivery ecosystem might look.

1. Introduction

In recent years, a burgeoning literature has emerged on the mobility as a service (MaaS) concept—a popular interpretation of future collaborative and connected urban transportation, centred on a changing society embracing a sharing culture which can satisfy our mobility needs without owning assets such as a car. MaaS emerges because of opportunities afforded by digital information platforms to plan and deliver multimodal mobility options in point-to-point trips and/or first-and-last mile travel to public transport journeys. MaaS packages will provide consumers with seamless mobility options with integrated payments through a single application in much the same way as unified mobile plans provide users with a choice of calls, text and data options.

The premise for MaaS is to transform mobility based on asset ownership (usually, in the form of a private vehicle) to one where it may be consumed *as a service*. Central to this proposition is the move from outright purchase of mobility provision to a subscription-based model with a higher marginal cost of consumption, as compared with vehicle ownership where much of the cost is borne initially upfront and thereby regarded as ‘sunk’. Accompanying this challenge of acceptance is the public’s ideological attachment towards cars (Mulley, 2017), but changing demographics offer encouraging signs for (at least in the

younger generation in the West) embracing this cultural shift. Already, some versions of MaaS have been implemented, with UbiGo¹ in Gothenburg and Whim² in Helsinki (now also Birmingham) as prominent examples, and core characteristics of MaaS schemes also beginning to be defined (Kamargianni et al., 2016, Jittrapirom et al., 2017).

The design and implementation of MaaS may be related to the *three Bs* “budgets, bundles and brokers” initially proposed in Hensher (2017: 91). **Bundles** relate to mobility packages which customers purchase, granting them a defined volume of access to each included mode (usually quantified by kilometres, hours or a percentage discount). Stated choice studies on end user preferences for bundled mobility products have thus far been conducted in London (Matyas and Kamargianni, 2017), Sydney (Ho et al., 2018), Newcastle upon Tyne (ITLS, forthcoming), as well as in work commissioned by industry bodies (e.g., Intelligent Transport Systems Australia) and consultancies (e.g., SYSTRA) as a way of revealing potential user preferences. Market testing MaaS is related to the **budgets** concept in terms of the need to elucidate the preferences of all stakeholders including demanders and suppliers in the MaaS supply chain. Far less work has to date been undertaken on the supply-side, particularly around potential business models and the likely emergence of mobility **brokers** (also known as aggregators) which bring together specialised businesses and value-add by offering that integrative function. Brokers form the conduit for connecting demanders of transport service and suppliers of the transport asset/capacity by facilitating the delivery of physical transportation (Wong et al., 2017).

In this paper, we focus on the *second and third Bs* in terms of mobility brokers and the budgets (preferences) of suppliers by identifying the conditions around which interested businesses might invest or supply in the MaaS entrepreneurial model. An empirical program of work based on interviews and participatory research helps inform the candidate attributes for inclusion in business investment utility models we are developing for MaaS. Our qualitative research focuses on key stakeholders including MaaS operators, conventional transport operators, public transport authorities and consultancies, especially those in Sweden and Finland where such schemes are presently well advanced. Through this, mobility contracts are designed and incorporated as part of a stated choice experiment to test supplier buy-in to the entrepreneurial model or broker interface for delivering MaaS. A face-to-face pilot with experts and industry stakeholders is then undertaken to finesse the survey instrument. MaaS as a concept is moving fast, but we believe we have begun the first formalised study to test some of the ideas behind service delivery—this paper presents our starting position on the journey to fill this important research gap.

The remainder of this paper is structured as follows. We next (Section 2) review urban passenger transport developments with a focus on Australia before introducing our framework for the MaaS ecosystem, including brokers and the idea of mode-agnostic mobility contracts. We then (3) present the method used to help us design these contracts and test our survey instrument. We (4) discuss candidate attributes like how modal mix, risk and return, business size and equity contribution, branding and government support might influence respondents’ propensity to invest/supply in these new business models. Following this, we (5) present the experimental design, including decisions around the sampling frame and what respondent characteristics or contextual variables to collect. We (6) conclude with a

¹ See <http://ubigo.se> (soon to be active in Antwerp and Stockholm)

² See <https://whimapp.com> (operated by MaaS Global and based on the SkedGo platform)

series of hypotheses and next steps in our effort to identify the structure of mobility broker models for delivering MaaS.

2. Delivering mobility as a service

A number of service delivery models have been proposed for MaaS, with a range of different actors and varying degrees of government involvement. With a special focus on Australia and our region, we consider collaborative efforts between public transport operators, transportation network companies (TNCs) and local authorities, as well as new ventures by non-mobility businesses adapting to stay relevant. A likely model is then proposed based on mobility brokers/aggregators and defined by mode-agnostic mobility contracts which form the basis for the empirical program of research.

2.1 Recent developments in urban passenger transport

Aided by digital technologies, TNCs have ushered in a new era of carsharing, ridesharing and bikesharing around the world. As of May 2018, there are already 35 (and rapidly growing) shared mobility providers active in the Australian market (Wong, 2018). Depending on geographic context and market demographic, these TNCs simultaneously compete with and complement public transport (Sadowsky and Nelson, 2017, Hall et al., 2017). There exists few instances of public transport operators cooperating with TNCs to deliver integrated service, particularly in providing first/last mile connections (see Boone et al. (2018) for a summary of cases in the US), and indeed only one such example in Australia—Canberra’s Night Rider+Uber³ initiative, backed by government. As part of the Future Transport 2056 agenda, the NSW government has funded on demand, microtransit-type trials in Greater Sydney (and soon to be rural and regional NSW). Bus operators have worked in conjunction with technology providers like Via, Routematch and TaxiCaller⁴ (though some have developed in-house products) to deliver some very innovative service offerings (Figure 1). In a way, this can be considered a primitive aggregator model of two specialised businesses—a public transport operator (the broker plus supplier) and a platform provider (supplier)—a precursor to what we propose for MaaS. The NSW government has now launched a MaaS Innovation Challenge⁵ which is an incubator process to bring eligible and interested parties together as part of a government-led MaaS trial (where government acts as the broker).

There is active interest across market sectors (in Australia) to partake in the future MaaS ecosystem. Public transport operators (at least those privately-owned) are looking to the future including more on demand service models plus incorporating autonomous technologies as they come online. TNCs like Uber are transforming into multimodal mobility platforms through acquisitions⁶ and partnerships. There is even interest in the community transport sector for MaaS (Mulley et al., 2017). Digital disruption is also occurring within non-service

³ In this instance, the ACT government has withdrawn their demand-responsive late-night buses from the suburbs and replaced them with more frequent service on their trunk (Rapid) network. Using promotional codes, customers benefit from a \$10 discount off their Uber connection from a public Night Ride service—of which the government contributes \$5 with Uber subsidising the other \$5. Taxi operators have lost out (despite being initially approached for this partnership) and evidence points to Uber driver-partners making better money from higher passenger turnover and shorter trips

⁴ Note that these all exist as B2B businesses in Australia (although Via operates in the B2C space in the US), and despite bus operators initially involving larger players like Uber, these proposals have not proceeded for a variety of reasons (see Section 4.4)

⁵ See <https://maaschallenge.transport.nsw.gov.au>

⁶ For example, Uber’s recent purchase of bikeshare startup JUMP, which took many (even) industry insiders by surprise

operators like vehicle manufacturers (concerned with future buyers as cars become autonomous and pooled, so are venturing into the service provision space), motoring associations (e.g., NRMA and RACV acquiring transport operators), insurance companies (future of liability with autonomy and also their customer base under shared mobility models), energy providers (wholesale electrification of the transport sector) and even property developers (future of parking and opportunities to bundle mobility as part of rental agreements).

Wong (2017) conducted an extensive interview program with industry leaders which identified the key ingredients for forward thinking businesses in future mobility. Innovation off-shoots and cross-sector collaboration emerged as the most effective for transforming an infrastructure and assets industry into a future services-oriented industry. What is evident is the increasing blur of sector boundaries as businesses collide and collaborate on new ventures (McKinsey and Bloomberg, 2016)—indeed a precursor to our idea of mobility brokers. Major unknowns, however, remain in the candidate actors (see Section 5.3) which we categorise under **mode-specific operators** (incumbent providers of *passenger service*) and **non-mobility providers** (new entrants) interested in partaking in the MaaS business model. The conditions around their involvement (and in what form) is also a major question, together with how incumbents might play strategic games (issues of bias) in an effort to maintain the status quo. These are amongst the unknowns we wish to test in this study.



Figure 1: A selection of on demand pilots operating in Greater Sydney. Clockwise from top left, Punchbowl Bus Company's Punchbowl On Demand (POD), Transdev's Ride Plus, Transit System's BRIDJ, Keolis Downer's Newcastle Transport On Demand, Interline Bus Services' Interline Connect and ComfortDelGro's OurBus

2.2 Defining the broker: New business models

Despite these developments, fully-fledged MaaS brokers/aggregators remain few and far in between. Part of the reason is because the design and institutionalisation of such business model is particularly demanding given that innovations occur outside the exclusive control of traditional firm boundaries (De Reuver et al., 2013). Romanyuk (2018) argues that MaaS is not a traditional business model but rather a networked business model co-created in a network of actors where the development process is continuous and iterative by nature. Kamargianni and Matyas (2017) propose seven candidate actors including transport operators

(plus mobility service providers like parking operators), data providers, technology and platform providers, information and communication technology infrastructure, insurance companies, regulatory organisations and universities/research institutions. Government is an active player amongst these actors which even as an interface magnifies the aggregation challenge. In their work, Kamargianni and Matyas (2017) advocate for a government agency or quasi-government entity (including a public transport authority) to assume this broker role. Jittrapirom et al. (2018a), however, in a Delphi study of 46 experts found transport operators as the preferred service integrator, followed by a third-party mobility provider and then local authorities.

We believe a government broker is a particularly challenging proposition since they might not only lack the incentive to innovate but also cause a potential conflict of interest⁷, especially where both public and private operators exist as is the case in Australia. In Australia (and most other Western economies⁸), government is increasingly removing themselves from service provision but rather only involving themselves at arm's length (Wong and Hensher, 2018). They are better positioned playing a regulatory function to ensure a 'level' playing field (including setting common standards) for different MaaS operators to compete. Government might still provide seed funding or act as a catalyst for innovation as is the case in NSW through their Future Transport agenda. We have hence assumed a private entity broker in our proposed model of the MaaS ecosystem for this research.

2.3 Situating the broker: Mode-agnostic mobility contracts

Having defined the broker, it is now necessary to situate it within a framework of demanders, suppliers and government (Figure 2). Brokers bring together suppliers of the transport asset/capacity, as well as other specialised businesses (like platform providers and financial enterprises), with this interface defined by mobility contracts. Opportunities exist for suppliers to also take up this broker role, as is the case with the aforementioned on demand trials in NSW (hence the blue shading). The broker in turn packages these raw services as bundles to demanders (end users), who purchases these products under a subscription or pay-as-you-go model. Given the new MaaS focus, government (who previously dealt directly with transport operators/suppliers) would now also interface with the MaaS broker/aggregator. Whether the broker(s) operate in an economically deregulated or a contracted environment (defined by what we term *accessibility contracts* as explored in Wong et al. (2017)) is beyond the scope of the present discussion. There is merit, however, in considering a framework without government interference initially to determine what the market is willing to provide before an institutional overlay is applied to ensure alignment with broader societal objectives. This is the approach we are assuming and has been supported by our fieldwork.

Our primary interest in this paper, however, is in the broker/supplier interface as governed by mobility contracts. Various forms of involvement are possible from these constituent suppliers ranging from mere financing (**investing**) of the service provider to **supplying** intellectual knowhow or tangible assets like vehicles and depots. These binary options form the basis for the choice variable responses in this study—see Section 5.1. We have further considered at length what MaaS might mean for the future of public transport contracts (Hensher, 2017). In Australia, there is a move from area-based, mode-specific, *output*-based

⁷ Though there is a view in the UK that this might be appropriate in an economically deregulated market

⁸ The US might be a sole exception

contracts (in effect, to deliver kilometres on defined vehicle types), to mode-agnostic, *outcome*-based contracts where the MaaS operator has the flexibility to deliver services using any mode of their choosing. This suggestion aligns with public transport institutional reform over the past 30 years, including the increasing desire for a hybrid model which brings together the best of a contracted regime with the benefits and incentives inherent under economic deregulation (Wong and Hensher, 2018). This serves as the context and theoretical underpinning for our empirical program of research to design the broker/supplier interface that is the mobility contract.

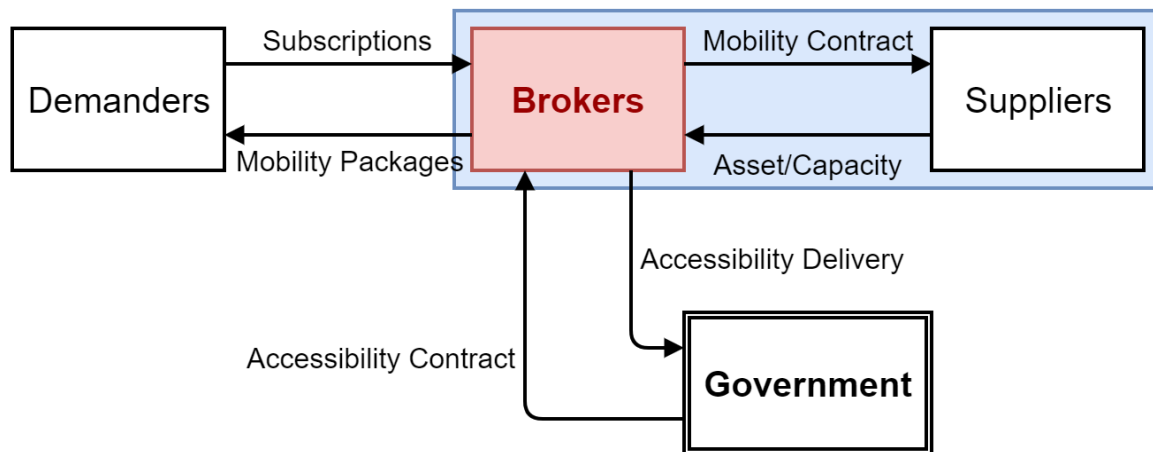


Figure 2: Our proposed framework for the MaaS ecosystem, comprising the new function for a mobility broker aggregating different suppliers and delivering integrated service to demanders—excerpt from Wong et al. (2017)

3. Methodology

To design mobility contracts, we embarked on a qualitative program of interviews and participatory research with key stakeholders during August 2017. Informal interviews (structured around a study visit) were held with senior decision makers of two incumbent MaaS operators active in Helsinki and their regional public transport authority HSL. The conversations included broader MaaS and public transport topics which continue to inform related work at ITLS. Our participatory research took place at the 15th *International Conference on Competition and Ownership in Land Passenger Transport*⁹ (known as the Thredbo series) in Stockholm where we ran a workshop over four days on the “‘uberisation’ of public transport and mobility as a service (MaaS)” (documented in Mulley and Kronsell (2018)). Twenty-seven participants representing academia, government and industry (including transport operators and consultancies)¹⁰ came together in this Thredbo workshop (henceforth, the *Workshop*) to consider the objectives of MaaS, regulatory challenges, policy recommendations and research priorities (amongst other issues). We took these opportunities in Helsinki and Stockholm to test which attributes ought to be included in mobility contracts, the units they should be specified in (and levels), as well as candidate contextual influences on choice outcomes.

With mobility contracts defined, we then designed them as hypothetical choice scenarios and incorporated these choice tasks and other contextual variables as part of a stated choice experiment (using the Conformat platform). Given the novelty of the MaaS concept and

⁹ See <http://www.thredbo-conference-series.org>

¹⁰ Participants hailed from Australia, Brazil, Finland, Germany, Japan, the Netherlands, Norway, Singapore, South Africa, Sweden, UK and US

limited application of stated preference methods on supply-side issues in *any* market, a face-to-face testing process was required to finesse and validate the survey instrument (conducted in February to April 2018). An internal pilot (n=9) within ITLS was undertaken with experts in both the choice methodology and transport policy to test the use of language, layout, presentation and suitability of questions for those less initiated. Data was not collected in this instance. This was followed by an external pilot (n=14) with industry leaders (including bus and rail operators, technology providers, vehicle manufacturers, consultancies and a government authority) with a focus on commercial sensitivity and the suitability of contextual variables. Data was collected from this external pilot to validate the model and confirm priors. The pilot results and qualitative research inform the remainder of this paper.

4. Mobility contract design

Informed by fieldwork, a mobility contract was built around five attribute categories and thirteen design attributes. Table 1 outlines the list of attributes and attribute levels whilst Figure 3 situates them within an example choice task design. We now discuss the rationale for including each attribute.

Table 1: Attribute levels (See Appendix Figure A4 for a more thorough description offered to survey respondents)

Attribute category	Attribute	Attribute levels ¹¹
Mobility offering (Revenue mix)¹²	Fixed route public transport	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100%
	On demand public transport	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100%
	Carsharing	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100%
	Taxi-like services	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100%
	Shared ridehailing services	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100%
Government support	Appeal to government through strategic/regulatory support	Enthusiastic, Lukewarm, <u>None</u>
	Monetary support for fixed route public transport	N/A ¹³ , Yes, <u>No</u>
Return on investment	Expected average annual return on investment	-10, -5, 0, 5, 10, 15, 20%
	Possible range for annual return on investment	± 2 , 4, 6, 8, 10% <i>applied additively to above attribute</i>
Business branding	MaaS business and service branding	[Own company] ¹⁴ -branded, New company branding, <u>Partner company branding</u>
Equity contribution		Small: USD 0.7, 1, 2.5, 4.5, 7, 10 million

¹¹ The reference/base level is underlined for dummy variables (as defined in the experimental design)

¹² Sum of attribute levels in this category is 100%

¹³ Nested attribute level—only displayed if fixed route public transport=0%

¹⁴ Respondents' actual organisation name is displayed within the choice task

Total value of the MaaS business ¹⁵	Medium: USD 7, 10, 25, 45, 70, 100 million
	Large: USD 70, 100, 250, 450, 700, 1000 million
Proportion equity and voting rights in the MaaS business	10, 20, 30, 40, 50, 60%
Equity contribution to the MaaS business	<i>Product of above two attributes</i>

4.1 Mobility offering (Revenue mix)

Mobility offering defines the mix of modes operated by a mobility broker and in turn offered as part of integrated packages to end users. Five modes were selected as part of the potential set: (1) fixed route public transport, covering urban mass transit options; (2) on demand public transport, the microtransit-type (like in NSW) operated as part of the contractual framework; (3) carsharing, including peer-to-peer, fleet-managed, return-to-base, one-way and roaming models¹⁶; (4) taxi-like services, including point-to-point services operated by TNCs; and (5) shared ridehailing services, microtransit led by private enterprise such as uberPOOL. On demand public transport differs from shared ridehailing services in that there is an underlying contract being serviced by a subcontractor (often a TNC and heavily subsidised). Mode labels and descriptors were refined (particularly this distinction) and the way values were presented tweaked (now with coloured bars) based on pilot feedback. The proportion of revenue from the five modes total 100%. Sole modal offerings (i.e., 100% of one mode and 0% of the rest) can thus be interpreted as a status quo mode-specific contract.

One variable that was tested extensively is how best to define the mobility offering mix. An alternative to revenue, as eventually selected, is service quantity, defined by some capacity measure like vehicle or passenger/seat kilometres. The complication in this case arises from clouding the internal cross-subsidisation potential within the broker business. Further, respondents might hold an implicit bias on the financial return or revenue potential from each mode (evidenced especially from the non-mobility pilot participants). Our approach ensures a level of transparency, but we recognise some limitation by excluding other revenue streams like advertising. Government subsidies or the lack thereof is explored in a separate attribute.

The need for this mobility offering attribute category is to test how different modal mixes might alter the propensity for respondents to invest/supply in the mobility broker. In the [Thredbo] Workshop, participants felt overwhelmingly that public transport ought to be at the core of any MaaS model. Whether public transport will naturally dominate, or must government play a role in directing the market through regulation and subsidies, is an unknown worth testing. We believe respondents from different sectors will be more inclined to support contracts with a particular modal bent (e.g., TNCs will support those with more taxi-like services). We further considered adding some demand variables for each mode (as informed by our end user survey in Ho et al. (2018)) but this proved problematic due to a likely endogeneity issue.

4.2 Government support

Two types of government involvement have been selected as attributes defining each mobility contract, both of which exist as dummy variables. First, strategic/regulatory support

¹⁵ Segmentation by value—see Section 4.5

¹⁶ Not all of these are presently available in Australia

refers to government in-principle support for MaaS, which may be exhibited through general policy direction (government masterplans, etc.) and further operationalised through the regulatory environment. Private investors are likely to avoid entry where there is only lukewarm government support or great market uncertainty. In pilot testing, this attribute was deemed even more important for publicly-owned transport operators. The Workshop recognised great tension between policy formulation and operator viewpoints, with regulatory support for MaaS which attempts to control for market failure thought to have the unintended consequence of stifling innovation (Mulley and Kronsell, 2018).

The second attribute refers to monetary support by government in terms of any subsidy adjustment for fixed route public transport (the status quo) given a greater MaaS focus in the future. This constitutes a nested attribute since it will not feature for mobility contracts without a fixed route public transport component. There are important links here with whether MaaS can evolve in the absence of government financial support, and also the possible need for community service obligation payments to the broker. The question of whether these subsidies will be passed on as a profit margin to the private enterprise is also relevant.

4.3 Return on investment

Potential return on investment is a critical part of any business decision. Two attributes are included in this category—the expected average annual return and the potential variance in this return, the latter capturing risk and uncertainty. The expected return (linked to profit margin) varies in 5% increments between -10% and +20%. Negative return levels are included given the ubiquity of TNCs making short term losses in an effort to gain (effectively ‘purchase’) market share, backed by venture capital investors. Negative returns can also be used as tax losses to write off tax liabilities from other businesses/ventures, as practiced by Australian toll road operators. The Workshop revealed Australian bus operators exhibiting a strong desire to enter the on demand market regardless of cost in order to showcase themselves as entrepreneurial, and hence help them win future tenders (particularly given government interest in on demand of late). We also found return expectations to vary considerably between businesses, with 8-30% having been touted (the upper end not uncommon with the community transport sector).

Return on investment might be a dominating attribute, but it is equally important to consider how this figure might vary. Realistically, the return might be based on some form of distribution (e.g., normal), but for simplicity we have not placed a probability for how this return might vary. Instead, a possible range for this return is defined, based on applying a number (2-10%) additively to the expected return. This is in contrast to applying risk multiplicatively as initially tested which caused great confusion amongst pilot respondents. True return on investment will hence range between -20% to +30%, though a much smaller range will be displayed within each mobility contract.

4.4 Business branding

Branding, bidding power and ownership of the customer emerged as important issues during the interview program and Workshop. On one hand, businesses are keen to maintain their brand since customer loyalty is part of the value proposition they bring to any relationship. This is especially the case with Australian bus operators, who pointed to their loss of livery and brand identity as part of recent changes to the contracting regime. In partnering with technology providers (for instance, for on demand trials in NSW), bus operators found it difficult to proceed with larger players like Uber who were adamant in maintaining their

brand, control of data and their digital platform. In the Helsinki case, the regional authority HSL expressed an element of regret in partnering with a MaaS provider since it meant a loss of control of their product, including marketing and ticket distribution channels.¹⁷

Sometimes, businesses might prefer to introduce an entirely new brand for a product or service, usually as a risk management strategy in case the venture is unsuccessful. Other reasons may include the existing branding is too localised (e.g., Punchbowl Bus Company¹⁸), to implement region-specific branding (e.g., Go-Ahead¹⁹), and when the parent branding is perceived to lack strength (e.g., FirstGroup rail business²⁰). Rarely will companies desire a competitor's brand on their product (though this is not the case in acquisitions—e.g., Transit Systems and BRIDJ), but we have designed three dummy levels to capture and test the realm of possibilities.

4.5 Equity contribution

The three equity contribution attributes devised are important in that they define the scale of the MaaS business and also the size of respondents' stake in the broker. The first of these attributes relate to the size of the broker business by total value in USD—selected as a global currency of trade. It is crucial to include a dollar item to estimate willingness-to-pay for individual attributes. Originally designed as a percentage of respondents' present turnover (e.g., 40% of your stated annual turnover of AUD 50 million), we found through the pilot that many respondents had difficulty providing this information. Another reason is that for a given percentage, larger organisations would see a significantly greater proportion of funds invested in what may be perceived to be a very small activity. For these reasons, a fixed range of dollars was devised, and segmentation by value in terms of organisation size implemented to ensure that the contracts remain relevant (almost a pivot design in effect). After thorough testing, we settled on using number of employees (collected as an earlier contextual variable) as a proxy for capturing organisation size, recognising the limitation in terms of labour intensity differences across sectors. The three respondent segments are:

- **Small enterprises:** ≤999 employees
- **Medium enterprises:** 1,000-9,999 employees
- **Large enterprises:** ≥10,000 employees

The second attribute relates to respondents' proportional equity contribution in the MaaS business, which range in 10% increments from 10-60%. Voting rights in the business are understood to be directly correlated with their equity investment, though in reality this may not always be the case.²¹ We propose to test how different broker sizes might affect interest in the business. For some companies, they may want a dominating share (and be monopolists) whilst others might be more risk averse and prefer a smaller starting stake. The actual contribution by respondents in USD is the final attribute and displayed in bold—a function of the previous two values. Actual contribution captures either the value of respondents' financial investment or investment in-kind, thereby monetarising assets to their equivalent amount in equity (capturing the two choice response variables *investing* and *supplying* in the contract). This may be more difficult for transport operators in the case where government

¹⁷ The partnership was also instrumental in helping the MaaS operator secure a large investment from a vehicle manufacturer which was not viewed upon kindly by HSL

¹⁸ Operates as PBC in recent Goulburn (NSW) acquisition

¹⁹ Usually operates city/region-specific brands in UK bus and rail businesses

²⁰ FirstGroup has been steadily unbranding their rail operations—e.g., First Great Western now Great Western Railway, First TransPennine Express now TransPennine Express

²¹ Consider Softbank and their ridesharing ventures around the world

owns the assets (e.g., management contracts in Singapore, and increasingly even in Sydney and Melbourne), but there exists the opportunity for operators to use contracted assets in private work—charters are one example (Hensher, 2015). The actual contribution range varies between USD 0.07-6 million for small enterprises, USD 0.7-60 million for medium enterprises, and USD 7-600 million for large enterprises. We ensured a degree of overlap to cater for organisation sizes at the margin.

Business Opportunities in Future Mobility

Opportunities in future mobility

Choice task 1 of 4
Please consider each mobility contract carefully and indicate which you would like to select. You may assume that these contracts are being offered in a metropolitan setting in a jurisdiction where Metro presently operates.

You can [click here](#) to open the glossary page to read the explanation of features again.

Features	Mobility Contract 1	Mobility Contract 2	Mobility Contract 3	None of these
Mobility Offering (Revenue Mix)				
Fixed route public transport	10%	20%	0%	
On demand public transport	20%	0%	10%	
Carsharing	20%	30%	0%	
Taxi-like services	10%	0%	80%	
Shared ridehailing services	40%	50%	10%	
Government Support				
Appeal to government through strategic/regulatory support	Lukewarm	None	None	
Monetary support for fixed route public transport	Yes	No	N/A	
Return on Investment (First Five Years)				
Expected average annual return on investment	15%	-5%	10%	
Possible range for annual return on investment	7% to 23%	-7% to -3%	2% to 18%	
Business Branding				
MaaS business and service branding	New, non-Metro brand	A partner company's brand	Metro-branded	
Your Equity Contribution				
Total value of the MaaS business	USD 10 million	USD 70 million	USD 10 million	
Your proportion equity and voting rights in the MaaS business	30%	30%	60%	
Your equity contribution to the MaaS business	USD 3 million	USD 21 million	USD 6 million	
Q1a. Which mobility contract would Metro most likely choose to INVEST IN ? Investing means becoming a financial shareholder without contributing any assets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 3: Screenshot of a choice task programmed in the survey instrument, for a hypothetical medium-sized mode-specific operator *Metro*

5. The survey instrument

Having identified relevant attributes for mobility contracts, we then designed them as stated choice tasks and incorporated these, together with contextual variables, into a state-of-the-art survey instrument. The qualitative research informed the survey structure as well as candidate respondents.

5.1 Choice tasks and choice responses

The mobility contracts were incorporated within a hypothetical setting using best practice design principles to define alternatives associated with designed levels of attributes (Louviere et al., 2000). Using Ngene, we generated D-efficient choice tasks of four alternatives (three mobility contracts plus one no choice/reference status quo—see Figure 3) in a six block, four sets per block design. We state that the choice scenario is situated within a jurisdiction where the respondent presently operates so as not to introduce an institutional dummy variable (representing country, for instance). Further, we had initially designed a Create-It-Yourself mobility contract scenario but found during pilot testing that it added no value. One major

issue was the lack of a constraining variable (like a cost parameter) unlike what is usually present in demand-side studies.

The Workshop explored a suite of partnership issues looking at market relationships in the MaaS era and the development of collaborations beyond standard procurement procedures (Mulley and Kronsell, 2018). Recognising this, we offered choice responses to either *supply* in or *invest* into the new MaaS business. The difference herein lies between contributing physical assets and assets in-kind (e.g., buses, depots, personnel) or becoming solely a financial shareholder in the broker business. A range of ranking systems were tested and we settled on a first choice *only* for the mobility contract (even when no choice was initially selected). To better understand how respondents might supply, we asked which assets they would contribute (technology, vehicle, bricks and mortar, right-of-way and personnel), what partners they might like to work with (other transport operators, platform providers and financial enterprises—all of which we regard as crucial), as well as how involvement will affect their present service offering (in the case of mode-specific operators). These three factors were originally incorporated as choice task-specific questions, but pilot testing found these responses not to be conditional on attribute levels.

5.2 Contextual variables and survey structure

The survey instrument included a range of contextual questions to further embellish the stated choice data—see full survey structure in Table 2. The survey begins with objective questions collecting respondent characteristics (Part B), including market sector, ownership structure, jurisdiction of operation and number of employees. The survey then branches and for mode-specific operators (C1), we ask for the modes they operate and for a vehicle count of each mode (as another measure of organisation size). This part initially included extensive contract-specific questions (around market arbitration, award mechanism, asset ownership, contract design, risk allocation and contract management) which were removed after the pilot round. Non-mobility providers (C2) are asked for their transport-related activities and interest in future transport initiatives. Both groups are requested to provide their return on investment expectations and perceived risk-free rate. Remarkably, industry respondents in the pilot exhibited no qualms in sharing this information (despite concern from academic experts).

Experience-conditioned discrete choice models constitute a recent advancement in the choice modelling literature, which to date has seen only limited applications—in transport modelling contexts (Hensher and Ho, 2016, Ben-Elia et al., 2008), healthcare (Neuman et al., 2010, Ryan and Ubach, 2003) and recreation (Wirtz et al., 2003). Each of these studies have found that respondent preferences are heavily influenced by their experience or familiarity with attributes and alternatives in the choice task. In the case of products or services not yet available on the market (like MaaS), then the conditioning agent can be considered as the respondents' awareness of an idea or experience. To account for heteroscedasticity conditioning in the analysis, we ask for respondents' (and their organisations') familiarity with the MaaS concept in Part H.

Hoeffler and Ariely (1999) makes a distinction between 'hard' and 'easy' choice tasks. Respondents in hard tasks exhibit greater preference stability but lower confidence in their choice, whilst those in easy tasks show lower preference stability, but with (a potentially misled) greater confidence in their decision-making. In Part I, we ask respondents to rate (on a Likert-scale) their decision-making confidence so as to allow us to validate the data whilst making a methodological contribution. The survey concludes with questions about

respondents' position title, responsibilities and years active in the industry to see whether these factors might carry particular biases in their responses.

Ethics approval was obtained (protocol number 2017/1020) for our final survey design²² titled **Business Opportunities in Future Mobility**. We generated unique URLs for online distribution to help us track progress and ensure that respondents need not finish the survey in one sitting. The final survey takes an estimated 15-20 minutes to complete, compared with up to 45 minutes in the pilot version.

Table 2: Structure of the survey instrument and function of each section

Page	Title	Function
A	Introduction	Introduces survey to respondent, including ethical information and contact details of researchers
B	Your organisation	Preliminary information on respondents' organisation characteristics
C1	Mode-specific	Questions tailored for mode-specific operators relating to their present contract
C2	Non-mobility	Questions tailored for non-mobility providers relating to their present operations
D-G	Choice tasks	Four choice tasks with alternative mobility contract options defined by a range of attributes
H	MaaS experience	Experience conditioning questionnaire on familiarity with the MaaS concept
I	About you	Questions relating to the respondents' individual characteristics

5.3 Candidate Respondents

A candidate sampling frame was defined in terms of jurisdiction, market sector and position title. We desired an international survey from the outset to obtain a global view, but recognise that some level of comparability between contexts is important, given the vastly different institutional and governance arrangements between countries. Hence, the jurisdictions of Australia, Hong Kong, Singapore, Japan, Western Europe and the United States²³ were selected as the sampling frame due to similar perspectives on risk and investment, and a level of dialogue and engagement between these economies. A number of neighbouring countries within these regions (e.g., Canada for US) were also selected where there is a high level of cross-cultural interaction.

The organisations selected were categorised under mode-specific operators (incumbent providers of *passenger* service) and non-mobility providers (new entrants) interested in partaking in the MaaS business model (Table 3). As mentioned, we decided that governments (i.e., transport regulators/authorities) would not form part of the candidate sample (unless they were an *operator* of transport service) since we deemed it unlikely they would partner within a mobility broker model (see Section 2.2). In pilot testing, logistics companies were excluded from the sample due to concerns about relevance.

²² Test link for final survey design: <https://survey.confirmat.com.au/wix/8/p2506968.aspx> (data not captured)

²³ South Africa was later added given the emergence of a broker model associated with digital platform interfaces for minibus taxi (informal transport) operators

One of the most important issues and major challenges in the study of business is identifying relevant decision makers within an organisation since preference responses are highly dependent on who provides the data (Balbontin and Hensher, 2018). Our specific focus is on *senior executives making investment decisions* within companies in the market sectors of interest. These include Managing Directors, Executive Directors, Chief Executive Officers, Chairmen and Strategy Directors but the actual respondent's position is difficult to control for due to different organisational structures between companies (hence the importance of capturing respondent-specific data, together with firm-specific data). It was also decided to allow capture of additional data points from within the one organisation (in many cases either part of the executive team, or Head of a different division/jurisdiction), collected as independent observations but to be pooled in subsequent analysis. In terms of recruitment, we considered hiring a business-to-business panel²⁴, but enquires indicated that they might be less effective in our target (and somewhat niche) market sectors. Instead, we engaged our partners in academia and industry (bus associations being particularly helpful) to assist with outreach as part of the respondent recruitment process.

Table 3: Candidate respondent sample in our two categories of interest

Mode-specific operators	Non-mobility providers
Public transport operator	Vehicle manufacturer/supplier
Taxi operator	Technology provider/startup
Transportation network company ²⁵	Financial enterprise
Carshare operator	Infrastructure operator
Bikeshare operator	Property developer
	Telecommunications provider
	Consultancy
	Insurance company
	Industry body
	Other

7. Next steps

MaaS is a nascent topic which has emerged only in the past several years. Quantitative and empirical evidence on the supply-side remains virtually non-existent so in this paper we begin the process of tackling the challenge to identify the conditions around which businesses might invest or supply in the mobility broker/aggregator model. The interview and participatory research process helped define the attributes to place in the mobility contract whilst pilot testing (n=9+14) helped us refine the survey instrument used in this novel application on MaaS. In retrospect, we underestimated the amount of work required for what is typically a straightforward experimental design process. We have commented on some of the challenges inherent and have prepared this paper with a view of streamlining future stated preference research on the supplier interface for MaaS.

We have now taken the survey into the business community to test. The aim is for 200 respondents, with an equal mix of Australian and international mode-specific operators and

²⁴ As an example, see B2B market research services offered by Survey Sampling International: <https://www.surveysampling.com/services/data-collection/online-surveys/b2b>

²⁵ Also known as booking service providers, private hire operators and mobility service providers (as distinct from mobility *as a* service operators)

non-mobility providers (50+50+50+50). This will give us an adequate sample and allow for the testing of a number of unanswered hypotheses and research questions, including:

- What are the conditions around which suppliers might buy-in and invest as MaaS service providers?
- How much of existing modal services might be built into multimodal contract offerings under MaaS and how much might remain in their existing mode-specific contracted form?
- Might mobility service brokers be an existing operator of a mode-specific service or a non-mobility provider?
- Might MaaS reduce subsidy for government in the provision of public transport services?

A companion paper (in progress) estimates models and tests hypotheses from this data to identify likely future designs for an emerging MaaS paradigm and the major players shaping its development. This is an innovative *first* view on this topic and the beginning of greater interest in identifying the commercial equilibrium for delivering MaaS. Major questions remain including whether this future will align with the broader societal and urban efficiency goals of government, or whether an institutional overlay will be required to ensure that these objectives are met (Wong et al., 2017, Jittrapirom et al., 2018b). How does it relate to what the market demands? Does MaaS need government support and guidance in defining the conditions of operation? Our research agenda is a first step towards informing these unknowns.

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Appendix



Opportunities in future mobility

The transport and mobility sector is rapidly evolving. New transport futures based on shared mobility and bundled offerings have been proposed, often known as **mobility as a service (MaaS)**. MaaS describes a personalised, one-stop travel management platform digitally unifying trip creation, purchase and delivery. A number of new, collaborative models have been suggested for how these services may potentially be delivered. Central to this are what we call **MOBILITY CONTRACTS** which form the interface for bringing together interested businesses as partners under a new entrepreneurial model. Each mobility contract is defined by a range of features which are explained in the example below.

This is an information screen to help you complete the next part of the survey.

Features	Explanation	Example Mobility Contract
MOBILITY OFFERING (REVENUE MIX)	The proportion of total revenue which will originate from each mode. At the extreme, this may be: <ul style="list-style-type: none"> 100% indicating a sole modal offering in the mobility contract 0% indicating the absence of a particular mode in the mobility contract 	
Fixed route public transport	Conventional public transport including buses, light rail, trains and ferries	20%
On demand public transport	Road-based public transport without fixed routes, stops and schedules, usually operated with minibuses and other bus-based vehicles	30%
Carsharing	Short term car rental, either from a dedicated fleet, or from other members of a car club	30%
Taxi-like services	Conventional taxis and point-to-point ridehailing like UberX, that are not shared with other customers	20%
Shared ridehailing services	Shared ridehailing like UberPOOL, usually operated with cars and minivans	0%
GOVERNMENT SUPPORT		
Appeal to government through strategic/regulatory support	Non-financial support for innovative transport services like MaaS	Enthusiastic
Monetary support for fixed route public transport	Financial subsidies for fixed route public transport	No
RETURN ON INVESTMENT (FIRST FIVE YEARS)		
Expected average annual return on investment	Profit margin you can expect to receive, on average—note that the motivation to expand market share may make this negative <i>in the first five years</i>	-10%
Possible range for annual return on investment	Range in which the above profit margin figure may vary between, capturing risk and uncertainty	-12% to -8%
BUSINESS BRANDING		
MaaS business and service branding	How the new MaaS offering will be branded. In this example, the MaaS business will take on a new, non-company specific brand	New, non-Metro brand
YOUR EQUITY CONTRIBUTION		
Total value of the MaaS business	Measure for the size of the MaaS business in USD	USD 10 million
Your proportion equity and voting rights in the MaaS business	Proportion of equity you own in the whole business, reflecting your voting rights	30%
Your equity contribution to the MaaS business	Amount in which Metro will contribute to the MaaS business. This may be in terms of a financial outlay (<i>invest in</i>) and/or assets which you provide in-kind (<i>supply in</i>), to the value of this amount	USD 3 million

You will now be asked to consider a series of hypothetical mobility contracts where you will have the opportunity to:

- **Invest in** the contract, meaning Metro will become a financial shareholder only in the MaaS business; and/or
- **Supply in** the contract, meaning Metro will run the MaaS business by contributing assets like technology, vehicles, property, infrastructure or personnel

Next

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Figure A4: Explanation of attributes offered to respondents as part of the choice task introduction in the survey instrument, for a hypothetical medium-sized mode-specific operator *Metro*