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Towards a Framework for Mobility-as-a-Service Policies

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Towards a Framework for Mobility-as-a-Service Policies

Public authorities are increasingly pursuing activities to pave the way for Mobility-as-a-Service (MaaS). The range of activities includes regulation reforms, technology developments and investments in trials. Despite progress, concrete MaaS developments are still limited. Thus, it remains uncertain how effective the current MaaS policies will be in terms of facilitating the development and diffusion of MaaS that generate public value. Drawing on collaborative innovation and sustainability transition literature, this paper aims to provide a basis for analyzing MaaS policies by introducing a framework that identifies aspects that such policies should address. An empirical analysis of Transport for New South Wales’s MaaS policy program is utilized to illustrate how the framework can be applied. The contribution to the transport literature is twofold. First, the paper refines the conceptual understanding of what MaaS is, and why it differs from the present state of affairs. Second, it advances the knowledge of how the public sector can facilitate its development and diffusion.

Mobility-as-a-Service; MaaS; Policy; Governance; Sustainability Transitions

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1. Introduction

Mobility-as-a-Service (MaaS) is a concept that bundles personal transport services from multiple transport service providers into a joint interface through which the services can be searched, booked and paid for (Heikkinen, 2014). MaaS has, in limited cases, been shown to make it easier for citizens to access and utilize several complementary transport services (e.g., Sochor et al., 2016). As a consequence, it has been argued that the prospective diffusion of the concept potentially could enhance the relative attractiveness of using transport services, in comparison to using privately owned vehicles (e.g., Hietanen, 2014). If this is the case, the uptake of MaaS could bring about considerable societal benefit, such as a smaller carbon footprint from personal transport (e.g., Kerttu et al., 2017) and reduced congestion and need for parking (e.g., Falconer et al., 2018), which in turn could lead to higher productivity, improved air quality and fewer traffic accidents (Goodall et al., 2017). Additionally, proponents argue that MaaS could reduce social exclusion (Polis, 2017) and bring new opportunities for economic growth (MaaS Alliance, 2017).

MaaS-like services have been trialed in numerous countries across Europe (cf. Kamargianni et al., 2016) and many more tests and actual implementations are planned for the upcoming years, including in Europe (e.g., KOMPIS, 2017), North America (e.g., FTA, 2016), Asia (e.g., MaaS Global, 2018) and Oceania (e.g., iMove, 2019). Nevertheless, MaaS is a novel concept, and the performed pilots have thus far been small-scale. Moreover, very few of the services have been systematically evaluated (Karlsson et al., 2017). Therefore, in reality, the knowledge about how to facilitate MaaS developments, and about what impacts on society a diffusion of MaaS might bring about, is limited (see Hensher et al. 2020).

MaaS proponents seem to collectively agree that the public sector has a key enabler role (cf. Kronsell and Mukhtar-Landgren, 2018) to play in MaaS, i.e., that implementation of new public policies is needed to create conducive conditions for MaaS developments (cf. MaaS Alliance, 2017). Public policies have been defined as “a set of interrelated decisions taken by a political actor or group of actors concerning the selection of goals and the means of achieving them within a specified situation where those decisions should, in principle, be within the power of those actors to achieve” (Jenkins, 1978, p. 21). More generally, public policies can be understood as “anything a government chooses to do or not to do” (Dye, 1972, p. 2) to either change or maintain some aspect of the status quo (cf. Howlett and Cashore, 2014). Drawing on this broad interpretation, we conceptualize public MaaS policies as all the activities that public agencies and their representatives pursue to influence the pace and the trajectory of MaaS developments.

Public authorities are increasingly implementing a range of policies meant to (more or less directly) pave the way for MaaS. Prominent examples in recent years include: a new transportation code in Finland that among other things demands all transport service providers in Finland to release single journey tickets for third-party resale (Audouin and Finger, 2018; Smith et al., 2018b); an attempt to launch a national intermediary MaaS integrator in Sweden (Smith et al., 2019b); a decision to integrate private transport services in the public national travel planner and to release public transport data and tickets for third-party resale in Denmark (cf. scenario 4 in Qvartz, 2018); and a launch of a publicly operated MaaS solution in Germany (UITP, 2016a). Moreover, public agencies around the world have invested heavily in research (e.g., the EU-funded project MaaS4EU), trials (e.g., SMILE in Austria), collaboration programs (e.g., KOMPIS in Sweden) and service development (e.g., an innovation challenge hosted by the public transport authority in the Helsinki region, Finland).

However, due to the nascent of the MaaS concept, we do not know if these activities will be sufficient for catalyzing concrete MaaS developments yet. Moreover, scholarly research on what the public sector can do to support the development of MaaS that contribute to policy objectives (e.g., Jittrariprom et al., 2018; Li and Voege, 2017; Smith et al., 2019a) have thus far not been compiled into easy-to-use formats for analysis. Accordingly, the emerging body of literature on MaaS offers limited guidance for policymakers. This paper sets out to fill that void, aiming to improve the general understanding of what MaaS is, and to cater for holistic governance approaches that successfully support action and steer the development of MaaS towards addressing policy objectives. Drawing on the present MaaS knowledge base as well as two strands of governance literature – collaborative innovation and sustainable transition studies – the paper first reviews what MaaS is, how its development and diffusion can be conceptualized, and what types of innovations it requires. This review serves as a basis for a proposed framework for MaaS policy analysis, which is introduced next. Thereafter, the current MaaS policy program of Transport for New South Wales is used as an example for illustrating how the framework can be applied. Lastly, suggestions on how the framework can be further refined are provided.
2. Theoretical point of departure

MaaS can arguably be understood as a collaborative and potentially disruptive innovation, meaning that MaaS developments require collaboration between multiple public and private stakeholders (cf. Sørensen and Torfing, 2011), and that the diffusion of MaaS might transform current practices within the personal transport domain (cf. Markides, 2006). This understanding of MaaS indicates that previous research on how to govern collaborative innovation as well as on how to govern long-term societal transitions could offer useful guidance for governance approaches to MaaS developments. Accordingly, two inter-related strands of governance literature are utilized as a theoretical point of departure: collaborative innovation and sustainability transitions.

**Collaborative innovation** approaches have been recommended as a key tool for braking policy deadlocks and organizational silos that hamper public innovation (e.g., Bekkers and Tummers, 2018; Crosby et al., 2017; Torfing, 2016). Collaborative innovation implies that “the locus of innovation is determined by the availability of innovation assets and not by the formal boundaries of a bureaucratic organization” (Bommer, 2010, p. 16). Thus, to leverage external ideas and capabilities alongside an internal focus, collaborative approaches open up the public innovation processes for a broad range of public-, private- and civil-sector actors, based on two fundamental assumptions: the existence of a plural and pluralist state (Osborne, 2006); and that “in a world of abundant knowledge, not all smart people work for you” (Chesbrough, 2003a, p. 12).

However, innovation scholars have recognized that public actors oftentimes face additional innovation challenges compared to private actors (e.g., Albury, 2005; Windrum and Koch, 2008). Formal rules, multi-layered hierarchies, organizational silos, divided political leadership and lack of incentives make it difficult for public actors to collaborate across their organizational borders (Sørensen and Torfing, 2012). Additionally, inherent differences between public and private actors seem to make it challenging to establish inter-organizational trust and to develop well-suited management structures and innovation processes for intersectorial collaborations. Therefore, managing collaborative innovation is a highly complex task (Agger and Sørensen, 2018), which might require fundamentally new approaches to innovation policies in general and to innovation governance in particular (Sørensen and Torfing, 2017). One of the key challenges in this space is to govern the new networks of actors (Sørensen and Torfing, 2016). This task is named meta-governance, and can simply be understood as second- and third-order governance (Jessop, 2002), in other words, the ‘governance of governance’ (Kooiman, 2003). Despite this on-going transformation, scholars have noted a tendency of public authorities in reintroducing elements of organization, such as hierarchy, rules and control over membership, to reduce uncertainty and reinstate routines (Ek Österberg and Qvist, 2018). This suggests that collaborative innovation tasks, such as MaaS, demands a mix of both new and traditional governance tools.

Policy instruments, has been suggested to “represent an interface between policymaker and policy targets and therefore give us insights into how given policy is implemented and with what effects” (Hellström and Jacob, 2017, p. 605). Manifold typologies on policy instruments have been developed to describe their mixes of techniques and social components. These include, but are not limited to: distinguishing between monitoring and behaviour altering instruments (Hood, 1986), sorting carrots, sticks and sermons (Bemelmans-Videc et al., 2011); describing policy instruments as either hard or soft (cf. Zehavi, 2012); and categorizing policy instruments as either regulatory, fiscal, agreements or information (Lascoumes and Le Galès, 2007). To centre on the mix of new and traditional governance tools (cf. Lang, 2016; Sørensen and Torfing, 2017), we adopt a categorization of hands-off tools – when the analyzed actor acts to enable and steer others actions, and hands-on tools – when the analyzed actor acts to drive or participate in developments themselves (cf. Sørensen and Torfing, 2018).

The underpinning logic for **sustainability transition studies** rests on three main propositions. First, society is facing significant sustainability challenges, such as climate change and social injustice. Second, these challenges demand swift and profound transformation to consumption and production patterns within the socio-technical systems that fulfill societal functions, such as electricity, transport and waste management. Third, such disruptive transformation can only come about through interactions between processes at three different analytical levels: landscapes, regimes and niches. Thus, in order to better understand how grand sustainability challenges can be addressed, research that (primarily) focuses on the regime-level of socio-technical systems, such as sustainability transition studies, are needed to complement the traditional sustainability debate that frequently addresses either the landscape-level or the niche-level (Köhler et al., 2017). As such, the main purpose of sustainability transition studies is to conceptualize and explain how sustainability transitions; i.e., fundamental transformations toward more sustainable modes of production and consumption (Markard et al., 2012); have unfolded in the past, are unfolding in the present, and can be governed to unfold in the future.
The literature on sustainability transitions has traditionally conceptualized transitions as “changes from one socio-technical regime to another” (Geels and Schot, 2007, p. 399). However, in a recent paper, van Welie and colleagues (2018) broadened this perspective. Based on an analysis of the Kenyan sanitation regime, they differentiated between service regimes and sectorial regimes, and defined them as follows: “Service regimes form around specific institutionalized combinations of technologies, user routines and organizational forms for providing the service. // Sectorial regimes refer to broader economic and societal realms (or organizational fields) that cover a societal function like transport, food, safe urban water, electricity and so forth” (ibid., p. 7). According to van Welie and colleagues (2018), a transition can, in addition to technological change, also encompass changes to the alignment between service regimes within a sectorial regime, alignment being understood as “a function of the complementarities between various services and inter-operability between the different service regimes” (ibid., p. 12). Four types of sectorial regimes were identified, differing on the level of alignment between service regimes: Monopolitic – one service regime dominates; polycentric – several well-aligned service regimes; fragmented – several service regimes, well-aligned internally but misaligned on sectorial level; and splintered – several service regimes, partially aligned internally, misaligned on sectorial level.

We utilize this perspective on transitions to comprehend how the development and diffusion of MaaS can be conceptualized. Furthermore, we draw significantly on the transition management strand of sustainability transition studies. Transition management is a normative and prescriptive approach to governing transitions that was developed in close collaboration with the national and regional governments in the Netherlands in the beginning of the 21st century (Loorbach, 2010). The approach is based on four types of activities: Strategic – aims to ensure that long-term visions are shared and embedded among collectives; tactical – serves to link individual actor strategies to the shared long-term visions; operational – links everyday activities to visions, broader policies and change agendas; and reflexive – includes the monitoring, assessment and evaluation of policies and practices. Proponents of the transition management approach argue that a mix of these types of activities can “create space for short-term innovation and develop long-term sustainability visions linked to desired societal transitions” (ibid., p. 163).

3. Decomposing Mobility-as-a-Service

This paper is based on the premise that a better understanding of what MaaS is and how it differs from current practices can pave the way for a more holistic perspective of what actions can support MaaS developments, and thus inform better policymaking on MaaS. Accordingly, in this section, we will first review how MaaS can be defined and conceptualized, and then discuss what types of innovation are required to make MaaS a reality.
3.1 What is Mobility-as-a-Service?

MaaS is frequently pompously described as a ‘new transport paradigm’ in both scientific papers and grey literature (e.g., Aapaoja et al., 2017b; Finger, 2015; Huhtala-Jenks and Forsblom, 2015; König et al., 2016; Rantasila, 2015). In other words, MaaS is understood as a transport pattern that is not only distinct from, but also incommensurable with previous transport patterns (cf. Kuhn, 1962). We disagree for two reasons. First, MaaS is not a new transport pattern in itself, but is rather a service model that can entail or embrace new transport behaviors such as decreased private car ownership, servitization of transport and increased multi-modality (Sochor and Sarasini, 2017). Second, MaaS is not suggested to imply incommensurable modifications to transport patterns (cf. paradigm shift). The envisioned effects can rather be described as incremental changes to how existing and emerging transport infrastructures, services and assets are utilized. Thus, we understand MaaS to be a type of service and not as a new technology-enabled transport paradigm (cf. KPMG, 2017).

Closely related to the preceding concepts such as flexible travellers (e.g., Boethius and Arby, 2011), combined mobility (e.g., UITP, 2011) and integrated mobility solutions (e.g., UITP, 2016b), the term MaaS was first popularized during the European Congress on Intelligent Transport Systems in Helsinki in 2014. MaaS was then described as “a system, in which a comprehensive range of mobility services are provided to customers by mobility operators” (Heikkilä, 2014, p. 8), and as “a mobility distribution model in which a customer’s major transportation needs are met over one interface and are offered by a service provider” (Hietanen, 2014, p. 1). Put another way, MaaS was portrayed as a type of service that is delivered by a new type of actor (mobility operator/service provider), and which gives users access to a palette of transport service options that suitably match their travel needs. Another aspect of MaaS that was highlighted in these early works, and that has been echoed in many later definitions (e.g., Datson, 2016; Ho et al., 2018; Jittrapirom et al., 2017; Kamargianni and Matyas, 2017; König et al., 2016; Wong et al., 2017), is that MaaS is delivered through a single digital interface (often described as an app or a platform) that enables users to plan for multi-modal travelling and provides a single mechanism for payment of all included services. Furthermore, MaaS was said to offer subscription plans in the form of mobility bundles (Hietanen, 2014). These three aspects, and the possible inclusion of dynamic policy-making, have later been categorized in a MaaS topology that recognizes four levels of integration: information; booking and payment; mobility packages; and policy (Sochor et al., 2018).

Drawing on the descriptions outlined above, we focus on the two most basic levels of integration: information; and booking and payment. We also focus on MaaS’ unique potential capacity of bringing together different types of transport services, such as traditional public transport, taxis and ride-sharing, but do not dictate what type of actor that delivers MaaS (e.g., incumbents or new entrants). Furthermore, we acknowledge that the majority of the potential value that MaaS can bring to users rests with the utility and usability of the included (physical) transport services. Still, in contrast to Falconer et al. (2018), we consider MaaS as the medium for accessing these services and not as the sum of them. Thus, we propose that MaaS can be understood as (see Figure 1):

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

Figure 1. Principle visualization of MaaS

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1 Nevertheless, the introduction of MaaS is anticipated to cause fundamental shifts to how personal transport services are produced and delivered, especially in terms of increased inter-organizational collaboration (Smith et al., 2018a). This is discussed in Section 3.2 and 3.3
Accordingly, MaaS’ can be large-scale and global or small-scale and local; offer either pay-as-you-go and/or subscription plans (tailor-made or not); integrate other functionalities and/or types of services as well; be delivered by any type of actor or actors; and be setup with or without an explicit purpose to produce benefits to society. Current examples of MaaS include Whim in Helsinki and Jelbi in Berlin. However, whether or not these examples of MaaS, or MaaS in general, will justify optimistic narratives such as user-centric (e.g., MaaS Alliance, 2017), intelligent (e.g., Kamargianni and Matyas, 2017), intuitive (e.g., MaaS Global, 2016), cost-efficient (e.g., Heikkilä, 2014), convenient (e.g., Falconer et al., 2018), comprehensive (e.g., Hietanen, 2014), seamless (e.g., Mukhtar-Landgren et al., 2016), and sustainable (e.g., König et al., 2016) remains to be seen.

3.2 How can the development and diffusion of Mobility-as-a-Service be conceptualized?

This paper strives to understand MaaS from a transition perspective. Still, the prospective diffusion of MaaS differs from the majority of case studies within the sustainability transition research stream. While most previous studies have focused on the introduction of new technologies (i.e., technological innovation), the most disruptive aspects of MaaS are arguably the enhanced alignments between different types of transport services (i.e. innovation on the ecosystem level). MaaS demands an increasingly integrated and coordinated value chain behind transport service provision, and that involved actors adjust accordingly (Smith et al., 2018a). Hence, drawing on the perspective on transitions introduced by Welie and colleagues (2018), we propose that the development and diffusion of MaaS, from a public sector perspective, can be conceptualized as (see Figure 2):

An attempt to transform the personal mobility system from (mostly) fragmented to (more) polycentric, with the intent of reaping public benefits by altering the modal split across the service regimes

The personal mobility regime can be understood as the sectorial regime, and the service regimes include both servitized modes of transport (e.g., public transport and taxi) and other modes of transport (e.g., privately owned cars and bicycles). These service regimes, which range from publicly- to privately-controlled, consists of “coherent and institutional arrangements of technologies, infrastructure, regulations, symbolic meanings, user routines and public discourses” (Welie et al., 2018, p. 8). They interact with each other at the sectorial level to provide personal mobility in a more or less seamless way. Moreover, the personal mobility regime is a subsystem of other regimes (each with its own institutional arrangements) and thus faces external influences. The potential public benefits (i.e. sustainability impacts) might, or might not be directly related to the personal mobility regime. For instance, potential direct benefits could be reduced congestion, improved accessibility or better cost-effectiveness in public spending on personal mobility, whilst indirect benefits could include improved public health or lowered greenhouse gas emissions.

3.3 What is needed to make Mobility-as-a-Service a reality?

Defined and conceptualized as above, MaaS does not appear to be that different from current practices within the transport sector, and we have indeed witnessed similar developments in other industries such as the hotel and air-travel businesses, where intermediary brokers have become standard practice in recent years. The recent experiences from Sweden and Finland, however, suggest that the process of developing MaaS is faced with manifold challenges (Smith et al., 2019c, 2018b). To increase the understanding of why this is the case, this section outlines nine areas of innovation which, based on the Nordic experiences, seem to be required for the development and diffusion of MaaS.
Towards a Framework for Mobility-as-a-Service Policies

**Terminology** – MaaS is currently understood and used in contradictory ways. For instance, several reports utilize the MaaS term to generally describe “a shift away from personally-owned modes of transportation and towards mobility solutions that are consumed as a service” (e.g., Ruter, 2016, p. 8). The network of actors that emerge under this shift is also sometimes referred to as MaaS (e.g., TNSW, 2018a). Others, that see MaaS as a type of service, argue over what elements need to be integrated, and how many transport services need to be included to justify the MaaS term (cf. Kamargianni et al., 2016). For instance, are multimodal travel planners such as TripGo examples of MaaS, or not? Furthermore, overlapping labels for the new roles in the value chain have been introduced (e.g., Kamargianni and Matyas, 2017; Smith et al., 2018a). As of now, the lack of a shared language seems to hamper trust building, knowledge exchange and joint efforts (Smith et al., 2017).

Knowledge exchange has repeatedly been identified as a central feature in innovation (e.g., Lundvall, 1992, 1988). It has also been argued that the importance of purposively tapping into others absorptive capacities is on the rise (Chesbrough, 2006; 2003b). An integral part in facilitating such knowledge exchange is to bridge the inter-organizational cognitive distance through investments in communication (Nootboon, 2000). In this process, a shared language is a highly valuable asset (Nahapiet and Ghoshal, 2000). Since MaaS is an intrinsically collaborative venture that demands the pooling of resources from both multiple actors (Mukhtar-Landgren and Smith, 2019), we argue that future MaaS developments require a terminology that facilitate communication and shared understanding (cf. Kamargianni et al., 2018; Karlsson, 2016; Sochor et al., 2018).

**Objectives** – Facilitating MaaS developments is not an objective in itself. MaaS is only a means to an end. From a public perspective, that end can be increasing the attractiveness of metropolitan regions, lowering negative externalities of the transport system, reducing social exclusion, identifying new business opportunities, a combination of these, or something else (cf. Hensher, 2018). Long-term visions are essential for formulating short-term objectives and evaluating existing policy, and can (if inspiring) be useful for mobilizing important actors (Rotmans et al., 2001). Thus, whatever the end is, it must be identified, defined, communicated and discussed to cater for a shared understanding of why and how MaaS developments can be supported (Sarasini et al., 2017a; Smith et al., 2019a).

However, agreeing on the goals of MaaS might be challenging, for many reasons. First, vision development, goal formulation, collective norm setting and other types of long-term strategic activities do generally not have a front seat and institutionalized place in regular policymaking. Due to political cycles, individual interests, and public pressure, public administrations are often centered on the short- and mid-term objectives (Loorbach, 2010). Second, MaaS can possibly tap into several different policy objectives, which are governed by distinct public authorities. This might make it difficult to decide on lead responsibility, and create coordination problems across public authorities in different domains and at different geographical scales (cf. Johnstone and Newell, 2018). Third, the evidence on MaaS’ societal impacts is very limited (Karlsson et al., 2017). As a consequence, it is rather difficult to specify, or even speculate on, concrete long-term goals for MaaS at this stage. Still, we propose that a clear formulation and communication of a vision could assist identification of appropriate actions, facilitate sense-making, and align MaaS-related initiatives (cf. Pernestil Brenden et al., 2017).

**Rules** – Policy reform has been defined as crucial to pave the way for MaaS (Li and Voege, 2017). In Sweden, the traditional public procurement process (Smith et al. 2017) and laws that influence public transport authorities (Smith et al., 2019c) have been perceived to hamper MaaS developments. In Finland, a major revision of transport legislation, aimed at promoting the introduction of new technologies, digitalization and innovative business concepts, has been implemented to lower entry barriers and to make room for innovations such as MaaS (LVM, 2017). At a basic level, there is indeed a need for a ‘rulebook’ that legalizes MaaS developments. On a more advanced level, the rules could potentially also facilitate and legitimize MaaS developments. Still, (and again) MaaS is only a means to an end. Therefore, MaaS rules should be aimed at steering the trajectory of the MaaS development towards addressing policy objectives too. MaaS rules must address market co-creating as well as market shaping and market fixing (cf. Mazzucato, 2018).

The transition management framework reflects a government to governance shift by proposing a prescriptive, collaborative, and multi-stakeholder governance program that relies on co-creation and social learning (Kemp and Loorbach, 2007; Loorbach, 2010, 2007; Rotmans and Loorbach, 2008). Guiding principles for transition management include inclusivity, democracy, diversity and openness. Essentially, this means that public actors involved in transition should make sure to have constructive dialogues with as many types of actors as possible, and to keep multiple pathways for the transition open for as long as possible (cf. Berggren et al., 2015). All things considered, the traditionally prescribed role for public actors in sustainability transitions can be summarized as a proactive and reflexive policymaker that should implement technology specific policies to
enable, promote (and assess) innovation that contribute to targeted sustainability transitions (e.g., Haley, 2017; Rogge and Reichardt, 2016). We urge policy-makers to explore how these guidelines can be applied to both enabling MaaS developments and steering the trajectory towards contributing to policy objectives.

Technologies – The global conversation about MaaS is arguably rather technocratic. In particular, data related topics such as quality of real-time information (e.g., Melis et al., 2018), incentives for data sharing (e.g., ITS Australia, 2018), standards for application programming interfaces (e.g., MaaS Alliance, 2017); how to resolve privacy and security issues (e.g., Callegati et al., 2016); and platform architectures (e.g., König et al., 2017) have been in the limelight. Furthermore, a cornerstone in the transport regulation reform in Finland, which largely aimed to push MaaS development, was to force transport service providers to provide operational data and single ride tickets for third-party resale and use in an interoperable format (Mukhtar-Landgren and Smith, 2019).

Despite arguing that technological innovation is not the most innovative aspect of MaaS (see Section 3.2), we acknowledge that technological-related developments are needed to pave the way for MaaS. Drawing on a broad understanding of technology, such as “the practical application of knowledge, especially in a particular area” (Mish, 2004, p. technology), the central technology of MaaS could be defined as the colloquial understanding of technology plus the service design (cf. Karlsson et al., 2016). Hence, we hold that the MaaS-related technology developments needed involve front-end and user-interaction developments as well as back-office developments, such as how data, offerings and payments are captured, stored and distributed across actors.

Business models – Another topic that has been central in the MaaS conversation is the need for new business models (e.g., Aapaoja et al., 2017a; Eckhardt et al., 2017; Sarasini et al., 2017b). MaaS builds on the integration of distinct and detached services that most often are either low margin or financed through public subsidies. This constitutes a difficult starting point for developing viable business models. Furthermore, business models for MaaS should preferably bring value to the users (e.g., increased time-efficiency, cost-efficiency or convenience); society (locally and globally); transport service providers (public and private); and MaaS operators and MaaS integrators (if external actors take on these roles). All in all, the business model for MaaS has (rightfully) been described as a Gordian knot that must be solved to cater for future MaaS developments (Smith et al., 2017).

The firm-centric business model concept (e.g. Osterwalder, 2004) first gained traction in conjunction with the dot.com bubble (Ovans, 2015). It describes mechanisms for how a firm creates, captures and delivers value (Teece, 2010). Neither focusing on the public sector, nor on public benefits, the business model has not been a dominant concept in either governance or sustainability transition literatures. Still, business model innovation is increasingly recognized as a vital component in societal transitions towards sustainability (Sarasini and Linder, 2018). To this day, MaaS scholars have discussed how different types of business models for MaaS can bring different public values in different settings (e.g., Sarasini et al., 2017a, 2017b). We argue that it is vital for the development of MaaS that this line of work is prolonged, and preferably diversified and transformed from theoretical reviews to investigations of real world applications of business models of MaaS.

Modes – The bedrock idea of MaaS is to integrate a rich mix of transport services that when combined can compete with the convenience and efficacy of owning a private car. For instance, the UbiGo trial in 2014 gave the participants access to public transport, car sharing, rental cars, taxis and city bikes (Strömberg et al., 2018). Furthermore, in addition to the focus on reducing car-traffic in urban, and sub-urban settings, MaaS has lately been proposed as a potential solution to social exclusion challenges in rural contexts (Aapaoja et al., 2017b; Eckhardt et al., 2018). Still, many of the services that are presented as potential components in MaaS have very limited geographical coverage. For instance, the recent strong global growth of car sharing programs has taken place mainly in the largest cities (Rotarirs and Danielis, 2018). Implementations in less densely populated areas seem to require a substantially different business model, with a greater public sector involvement (ibid.).

As noted earlier, specific transport services can be seen as the service regimes (van Welie et al., 2018) that MaaS seeks to align. Another perspective on MaaS, inspired by the systems approach of transition literature, is to perceive the transport services as product-service subsystems that feed into the MaaS system (cf. Joore and Brezet, 2015). The development of MaaS is thus dependent on the resource formation processes in the subsystems being coupled to each other (cf. Binz and Truffer, 2017). Accordingly, we propose that investments in transport services, and structural couplings between them are indirect but important investments in the development and diffusion of MaaS.
**Alternatives** – MaaS is often marketed as a service that, similar to when private cars were introduced to the broader public, will offer users an improved level of freedom through greater choice (e.g., ‘the new freedom of mobility’; ‘better than owning a car’; and ‘the end of private car ownership’). Hence, the success of MaaS largely rests on its relative attractiveness compared to owning and using private cars. MaaS developments are therefore caught between two socio-technical regimes, and contingent upon transforming the structures that maintain both the personal transport service system and the system of automobility (cf. Parkhurst et al., 2012). The two systems are both supported by a complex array of institutional arrangements, and many current actors and employees are dependent on them.

The sustainability transition literature has paid much attention to path dependencies and lock-ins of regimes as well as on how to nurture and scale niche innovations. In contrast, relatively little has been done to understand processes and mechanisms for accelerating the unlocking of prevalent regimes, such as automobility in this case (Smith et al., 2010). However, it has recently been argued that goals for economic growth and jobs are factors that make it hard for new niches to replace extant regimes (Foxon, 2017). Redevelopment of human capital and knowledge have also been identified as important enablers of transitions (Andersen and Gulbrandsen, 2018). All in all, we suggest that measures that increase the relative attractiveness of transport services (e.g., through urban design and transport subsidies) and facilitate the decline of the current automobility regime (including viable exit alternatives) are essential for the future development of MaaS.

**Partnerships** – Public transport is frequently promoted as the backbone of MaaS (e.g., UITP, 2016b, 2019). Thus, the public sector has (at least) one operative role to play in MaaS. Furthermore, the MaaS concept builds on public-private innovation collaboration, but multiple institutional barriers hamper the formation of such collaborations (Munksgaard et al., 2012). Moreover, to convince both commercial and non-commercial (i.e., publicly subsidized) modal services to cooperate under MaaS has proved to be a major challenging thus far (e.g., Smith et al., 2019b). To enable fruitful MaaS partnerships, the public sector will have to transform its general approach to public innovation, in terms of increased external influence on goal-setting, public assets and public service delivery (Feller et al., 2011), as well as in terms of adopting internal organization, innovation management and human capital (Agger and Sørensen, 2018). More specifically, the inherent differences between the diversity of actors that are meant to inhabit the MaaS ecosystem create a need for new models, processes and tools for public-private innovation partnerships (Smith et al., 2019c).

Beyond arguing that innovation collaborations can boost all phases of the public innovation process by harnessing inter-organizational differences (e.g., Ansell and Torfing, 2014), the literature on collaborative innovation offers plenty of guidance on how governments can transform to better initiate, support and guide innovation collaborations in networks (e.g., Sorensen and Torfing, 2016). Scholars within this field encourage public authorities to apply a mix of hands-on and hands-off tools (both new and traditional, cf. Ek Osterberg and Qvist, 2018) to “engage network members in the destruction of existing beliefs and practices and the creative development, testing and implementation of new ones” (Sorensen and Torfing, 2017, p. 834). Furthermore, as MaaS is a nascent concept, experimentation is central to understand how MaaS and MaaS partnerships should be shaped. Different types of experimental governance approaches has been suggested as useful for testing ideas, creating profound influence, multiplying influence and promoting systemic change (Laakso et al., 2017). We argue that public authorities should explore network-based and experimental approaches to public innovation, to enable partnerships with the private- and civil sectors that advance the development and diffusion of MaaS.

**Diffusion** – Innovation is a multi-stage process whereby organizations transform ideas into products, service or processes, and in which end-users adopt and use these (Baregheh et al., 2009; Sorensen and Torfing, 2011). In other words, the full innovation procedure, from initial idea to societal impacts, is required prior to MaaS can be rightfully labeled as an innovation. The MaaS conversation has thus far mostly focused on the development phase. For instance, the huge costs associated with marketing new solutions (such as MaaS) in general, and unknown brands (such as MaaS Global) in particular, have frequently been overlooked in the MaaS literature.

An analytical distinction can be made between three inter-related systems: innovation system; production system; and distribution-market system (Malerba, 2002). These systems that can be more or less related (Bergek, 2018), might or might not include the same set of actors, and can take place in the same or different geographical locations (Quitzow, 2015). Therefore, specific policies might be required to target the diffusion of innovations. On an individual level, the diffusion process has been proposed to follow a five-step process of knowledge, persuasion, decision, implementation and confirmation (Rogers, 1995). Among other things, this process is influenced by relative advantage, compatibility, complexity, trialability and observability (ibid.). Thus, we suggest that MaaS policymakers should consider how MaaS policy program can address these attributes as well.
4. Towards a Framework for Analysis

Drawing on the notions that the development and diffusion of MaaS can be conceptualized as a socio-technical transition (see Section 3.2.) and that the realization of MaaS requires multiple types of innovation (see Section 3.3.), we propose a framework that caters for two types of analyses: What types of innovation does a specific MaaS policy program address; and how long-term and regime focused vs. short-term and service centric is the MaaS policy program? We suggest that the nine identified innovation types can be used as a starting point for what a MaaS policy programs should target in order to sufficiently pave the way for the development and diffusion of MaaS that contributes to policy objectives. For means, we use the concept of policy instruments, and adopt the idea of mixing hands-off and hands-on tools from the collaborative innovation literature. Furthermore, we draw on the transition management framework by categorizing the instruments upon whether they are primarily strategic, tactical, operational or reflexive in character (still, it should be recognized that the boundaries between these categories are blurry), see Table 1.

Table 1. A framework for analyzing MaaS policy programs

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Strategic</th>
<th>Tactical</th>
<th>Operational</th>
<th>Reflexive</th>
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<td>Establishing a shared language on MaaS</td>
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<td>Objectives</td>
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<td>Crafting inspiring visions and targets for MaaS</td>
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<td>Rules</td>
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<td>Lowering institutional barriers and steering the trajectory towards contributing to policy objectives</td>
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<td>Technologies</td>
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<td>Developing front-end, back-end and support systems for MaaS</td>
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<td>Business models</td>
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<td>Assisting the development of viable and sustainable business models for MaaS</td>
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<td>Modes</td>
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<td>Pushing the diffusion and availability of transport services, to include in MaaS</td>
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<td>Alternatives</td>
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<td>Supporting the relative attractiveness of MaaS, compared to alternative options</td>
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<td>Partnerships</td>
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<tr>
<td>Assisting inter-organizational collaboration, experimentation and mutual learning</td>
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<td>Diffusion</td>
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<tr>
<td>Accelerating the adoption and use of MaaS</td>
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</table>

The following definitions are used: Strategic activities focus on culture and address the long-term development (15+ years) of the personal mobility regime (sectorial level) or broader regimes; tactical activities focus on structures and address the mid-term development (5-15 years) of personal transport service regimes; operational level focus on practices and address the short-term development (0-5 years) of concrete personal transport services; and reflexive activities focus on monitoring and evaluation actors, agendas and processes involved in the transition towards increased alignment between transport service regimes (cf. Loorbach, 2019). Next, we use Transport for New South Wales’s MaaS policy program to illustrate how the framework can be applied.

4.1 The example of Transport for New South Wales

Transport for New South Wales (TfNSW) is a statutory authority that manages the transport services in the Australian state of New South Wales. The analysis of their MaaS policy program presented here is based on 11 individual interviews and 8 group interviews conducted in late 2018 (average interview time: 64 minutes). The interview sample, which was selected based on a snowball sampling technique (cf. Marshall, 1996), covered 33 people in total – 14 employed by TfNSW, seven representing other Australian public authorities, ten active in the private sector, one from academia and one working for a non-profit organization.
The interviews covered personal perceptions of MaaS, past and present MaaS activities in New South Wales, main challenges, the undertaken roles by TfNSW, and TfNSW's use of policy instruments. They were recorded and listened through by the first author. Pertinent parts of the interviews were then transcribed and analyzed inductively. This analysis revealed what activities that the interviewees perceived as influential for on-going and future MaaS developments in New South Wales. The activities, which are described next, were categorized using the proposed analysis framework, see Table 2 in the Appendix².

**Strategic activities** – In 2016, TfNSW released a 40-year transport strategy labeled the Future Transport 2056 Strategy (TfNSW, 2016a). The strategy outlines six outcomes that should guide long-term investment, policy reform and service provision to harness innovation and support a modern transport network. One of the six wanted outcomes is that “customer experiences are seamless, interactive and personalized, supported by technology and data” (ibid. p. 15). Recognizing that services are increasingly being delivered by a diverse group of external actors, and referencing positive results from MaaS experiments in Gothenburg and Turku, the chief tactic for achieving this outcome is set to: moving to MaaS and beyond. MaaS is here defined as “a business model for customers to access transport services in which customers can use a single account and booking interface to access a broad range of transport modes, none of which the customer owns” (ibid. p. 169).

**Tactical activities** – Led by the Minister for Transport and Roads in New South Wales, TfNSW has a strong focus on emerging technologies. To guide this work, TfNSW complemented the overarching transport strategy with a more detailed action plan for technological innovation: the Future Transport Technology Roadmap (TfNSW, 2016b). Developed in close collaboration with the transport and technology industries, the roadmap pinpoints five key technology tactics for personalizing transport and for unlocking the full value of the existing and future transport networks. These tactics advocate investments in: digitized, automated and smart high-capacity public transport; complementary shared and demand-responsive services; systems for data capture, sharing and analysis; and seamless information and payment systems. These components were frequently referred to as pieces of the MaaS puzzle in the interviews. The spirit of the technology roadmap has also been disseminated to external actors through a leaflet (the future mobility prospectus) and videos (the Move series).

In terms of rules and regulations, several of the interviewed TfNSW employees described a general on-going reform of passenger transport regulations from prescribing which vehicles, technologies and business models transport service providers (contracted and not) should use, to increasingly focusing on the preferred outcomes of the services instead. A major modification in this space, with relevance for MaaS, is the replacement of previous regulations for taxis and hire cars with the point-to-point act and regulation (NSW Government, 2018, 2019). This reform, which was made in the wake of Uber entering New South Wales, made ridesourcing lawful and removed license requirements on all booked-only hire vehicles (e.g., ridesourcing, limos and community transport). The reform also moved the responsibility of vetting drivers from the government to the companies providing these services as well as to companies providing ridehailing services such as taxis. According to one interviewee, the effects thus far include an almost doubled market size for booked services (in terms of the number of drivers), better coverage at regional centers, and more niche services being brought to the market. Potentially, this improves the possibilities to compile an interesting MaaS offering in New South Wales.

A parallel regulatory reform, which many interviewees brought up, is the transformation of how public transport operator contracts are tendered and what components the contracts include. TfNSW has in recent years been increasingly interested in procuring multi-modal contracts (e.g., in Newcastle for bus, ferry and light rail). TfNSW has also started to introduce more flexibility for the bus operators in particular – both during the negotiations, and while the contracts are running (e.g., in region six in Sydney – see Perera et al. 2019). As noted by several interviewed operator representatives, these changes might improve contracted operators’ possibilities and incentives to introduce new types of modes and MaaS-like solutions.

To investigate how regulation reform can improve business opportunities in New South Wales, the state government launched a regulatory sandbox program in 2016. A regulatory sandbox is a time-limited testing environment where regulatory barriers are removed on a trial basis. One interviewee discussed its applicability to MaaS, suggesting that it can be used to pinpoint inhibitory regulations. Moreover, several interviewees used TfNSW’s dealings with Uber as an example of its general tactic of initially ‘getting out of the way’ – stepping in to regulate first when it has learnt about the consequences of diffusion of a certain disruptive innovation.

² To ensure the validity of the analysis, the descriptions and categorizations of the policies were double-checked with the interviewees. Moreover, initial versions of this paper have been presented at several academic conferences and workshops. The analysis has been reviewed and discussed by multiple transport scholars via these processes, and refined thereupon.
With regard to more hands-on action, TfNSW is investing heavily in technology. Colloquially labeled as ‘no regrets initiatives’, the technology roadmap pinpointed technology projects that were believed to improve transport no matter how the future unfolds. One such project focused on making transport data available to external actors. TfNSW has invested in an open data portal (opendata.transport.nsw.gov.au) that among other things contains timetables, real-time information on the location of public transport vehicles, and historic data on patronage. As of October 2018, its five most frequently used application-programming interfaces received between 1.6 and 2.5 million calls weekly. One interviewed TfNSW employee claimed that it currently is the largest portal for open transport data. Another speculated that the scope of the open data platform could be expanded to facilitate a future data broker role in MaaS for TfNSW.

TfNSW is also investing in payment technology. The smart ticketing system for public transport (Opal) has been implemented in other mobility services, such as private ferries and demand-responsive shuttles. The plan is to create a statewide single-account mobility platform and enable other mobility service providers to integrate into it (TfNSW, 2016b), suggesting that TfNSW wants to position the Opal system in the center of the future MaaS ecosystem. However, TfNSW has additionally trialed contactless payment techniques, indicating that it is willing to open up for external payment systems too. At present, certain credit or debit card can be used as the payment method on trains, light rail and some ferries in Sydney by tapping on and off at Opal readers.

Beyond regulatory reform and technology investments, TfNSW has a strong focus on industry collaborations. As described by one interviewed TfNSW employee, being open for business is a core strategy of TfNSW. This approach permeates traditional government activities and inspires new forms of collaboration. In terms of traditional activities, several interviewees talked about how collaborative the processes of developing the strategy documents as well as the most recent tender processes were (both mentioned above). In terms of new ways of collaborating, the interviewees most frequently brought up the future transport digital accelerator – a program meant to facilitate collaboration with the private sector on digital innovation. Located in a large-scale start-up hub that hosts around 2,500 innovators, the digital accelerator program attempts to support and fast-track the initiatives pinpointed in the technology roadmap by offering a milieu and a process for scoping and understanding problems; ideating, prototyping and testing solutions; and transitioning solutions into ‘real-world’ implementation and delivery (TfNSW, 2018b).

**Operational activities** – TfNSW is largely focusing on technology investments and industry collaboration on the more short-term and service centric level. For example, one technology investment, with relevance for MaaS, is the recent digitization of the community transport services provided under contract to TfNSW. Community transport services mainly support elderly people across NSW and people at risk of being transport disadvantaged in rural and regional parts of New South Wales. It has been around for many years, and serves about 100,000 users and a million trips per year. A centralized trip allocation and booking system has been implemented to help the contractors provide consistent levels of service, and to obtain better information about what trips are made and how assets are utilized. For MaaS, the digitization creates opportunities for integrating the community transport system into a wider MaaS offering (see Mulley et al. 2020).

As part of the digital accelerator program, TfNSW hosts innovation challenges. The first one, entitled ‘the MaaS challenge’ and undertaken in 2018, departed from the following problem statement: “How would you give customers optimal door-to-door mobility service options and seamless combinations for their situation, including the first and last mile?” (TfNSW, 2018a, p. 4). The challenge produced eight MaaS-related trials to be conducted in 2019-2020 These will be financed by TfNSW and performed in collaboration with private firms. Beyond the planned MaaS trials, TfNSW has 20 on-going trials on demand-responsive solutions; ten in the greater Sydney region, and ten regional services. One interviewee described these as being done in preparation for tendering more flexible bus contracts that open up for demand-responsive services. Arguably, these services can become interesting components of future MaaS offerings.

**Reflective activities** – Lastly, TfNSW strives to assess the development and diffusion of MaaS through both hands-on and hands-off actions. While the hands-on activities seemed to follow traditional patterns, and thus were less discussed during the interviews, the hands-off actions were more tangible. For instance, to collaborate with academia, TfNSW established a research hub in 2016. Currently employing six people at TfNSW, the research hub offers four types of collaboration: short collaborations such as hackathons; undergraduate research projects; postgraduate research; and major research collaborations. Seven strategic research directions, designed to form the basis for TfNSW’s engagement with research partners, has been published. One of them, labeled future mobility, strives to expand the evidence base for achieving an integrated transport system that helps facilitate new service models such as MaaS.
4.2 Reflections

One interviewed TfNSW employee offered the following view on TfNSW’s MaaS policy program: “all of these things that we have done are lego blocks to what you call MaaS. A lot of people kind of talk about MaaS, and what it could be. What we have done in New South Wales is that we have delivered on the key enablers to make MaaS a reality”. Our analysis, powered by the proposed analytical framework, offers a more nuanced view.

The analysis shows that TfNSW’s MaaS policy program includes a rich mix of both hands-off and hands-on tools. Collectively, these tools target six out of nine of the types of innovation identified to be essential for the development of MaaS: terminology, objectives, rules, technologies, modes and partnerships. Missing links, with regards to types of innovation, are policy instruments that assist the development of viable business models; support the relative attractiveness of MaaS, compared to other transport alternatives; and accelerate the adoption and use of MaaS. Hence, the analysis indicates that supplementary activities might be needed to deliver on all key enablers. Still, it is arbitrary to study one actor’s policy program in isolation. For example, the fact that TfNSW currently do not seem to support the relative attractiveness of MaaS might not be a problem, if this type of innovations is targeted by other actors’ policies, or by other societal developments.

TfNSW’s MaaS policy program builds on the vision for transport established through the future transport strategy: transport is an enabler of economic and social activity, and contributes to a productive economy, livable communities and a sustainable society (TfNSW, 2016a). Yet, the tabulation of policy instruments (see Table 2) illustrates that the program has a strong emphasis on tactical and operational activities. Not all, internally or externally respondents, seemed to understand how these mid-term and short-term activities relate to the greater long-term picture. Several interviewees said that the message from the TfNSW leadership was to harness technology, but that the conversation rarely focused on what the actual sought policy ends were, beyond improved customer experience. This indicates that there is still work to do for TfNSW in relation to structuring the socio-technical problems to be addressed and to envisioning and communicating future pathways.

The analysis did not review either the effectiveness or approval of the policy program. For instance, a few interviewees complained about matters such as inadequate granularity of the released open data, and limited scopes of the eight MaaS trials (many if not all trials to date are small-scale and mostly related to enhancement of trip planning apps); questioning TfNSW’s true commitment to supporting external MaaS development, and indicating that these policies perhaps do not sufficiently support the targeted ends in their view. In other words, although the analysis illustrates that the policy program aims to address six out of the nine essential types of innovation (Section 3.3), it does not establish that the policy program is successful in doing so.

5. Concluding remarks

Drawing on concepts from the governance and transition literatures, this paper provides a novel take on how MaaS can be understood and conceptualized. The key point here is that MaaS is neither a new transport mode, nor a new transport paradigm. Rather, the development and diffusion of MaaS is a purposive intent to incrementally transform the personal mobility system towards increased alignment between transport services. Generally, the objective is to produce some types of wider benefits by driving a modal shift in favor of servitized modes. The suggested MaaS conceptualization needs to be further discussed and refined as we gain a greater understanding of the MaaS phenomenon. In particular, this review should be based on analyzes of increasingly large-scale (i.e. more users) and divers (e.g. other user groups) MaaS operations. However, the conceptualization would benefit from theoretical considerations too. For instance, it seems relevant to consider how it can be improved to better capture the end-user perspective, i.e. illustrate the individual transport behavior changes that the suggested public benefits of a MaaS diffusion rest upon. Activity theory might be a helpful instrument in this regard (cf. Strömberg et al., 2016, 2018b). Furthermore, the literature on new institutional economics (e.g., Williamson, 2010) could help explain MaaS’ opportunities to lower transaction costs and to align the preferences of MaaS users and transport service providers’ through mobility contracts (e.g., a MaaS subscription plan).

The paper identifies nine types of innovation suggested to be essential. The main message here is that MaaS does not fit well with current institutional arrangements (cf. Karlsson et al., 2019). Consequently, the development and diffusion of MaaS requires more than mere deployment of new technologies. Yet, the proposed list is far from all encompassing. Researchers with supplementary perspectives on and experiences of MaaS should review and revise the identified types of innovation. For example, the present version of the list does not emphasize key internal processes, such as establishing a culture of innovation, anchoring and reorganizing, which arguably have been amongst the greatest challenges for Swedish public transport authorities thus far (Smith et al., 2019c).
Finally, the paper develops a framework for analyzing MaaS policy programs and illustrates how it can be applied, utilizing TfNSW’s MaaS policy program as an empirical example. Our main intent here is to provide a straightforward tool that can be used by scholars and practitioners to identify matches and mismatches between MaaS policy programs and what is needed to facilitate and govern the development and diffusion of MaaS. As discussed in Section 4.2, the framework has at least two major limitations, which perhaps could be refined in ongoing research - it does not consider contextual elements or other actors’ MaaS-related actions; and it does not capture the reception or effects of the implemented policies.

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Towards a Framework for Mobility-as-a-Service Policies


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Appendix

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<th>Terminology</th>
<th>Strategic</th>
<th>Tactical</th>
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<th>Reflexive</th>
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<tr>
<td>Hands-off/hands-on: Future transport 2056 strategy</td>
<td>Hands-off/hands-on: Future technologies roadmap; Future mobility prospectus; Move TV series</td>
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<td>Objectives</td>
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<td>Rules</td>
<td>Hands-off: Passenger transport law reform; Flexible bus contracts; Multimodal tenders. Hands-on: Regulation sandbox program</td>
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<td>Technologies</td>
<td>Hands-on: Open data portal; Opal pay</td>
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<td>framework; Contactless payments</td>
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<tr>
<th>Modes</th>
<th>Hands-off: Point-to-point reform</th>
<th>Hands-on: Digitizing community transport; On-demand trials</th>
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<tbody>
<tr>
<td>Partnerships</td>
<td>Hands-off: Collaborative strategy processes; Collaborative tender processes. Hands-on: Digital accelerator</td>
<td>Hands-on: MaaS innovation challenge</td>
</tr>
</tbody>
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**Table 2.** An analysis of Transport for New South Wales’s MaaS policy program