Public transport regimes and mobility as a service: Governance approaches in Amsterdam, Birmingham, and Helsinki

Hirschhorn, Fabio; Paulsson, Alexander; Hedegaard Sørensen, Claus; Veeneman, Wijnand

DOI
10.1016/j.tra.2019.09.016

Publication date
2019

Document Version
Final published version

Published in
Transportation Research Part A: Policy and Practice

Transportation Research Part A 130 (2019) 178–191

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Public transport regimes and mobility as a service: Governance approaches in Amsterdam, Birmingham, and Helsinki

Fabio Hirschhorn[a,*], Alexander Paulsson[b,c], Claus H. Sørensen[b], Wijnand Veeneman[a]

[a] Faculty of Technology, Policy and Management, Delft University of Technology, the Netherlands
[b] Swedish National Road and Transport Research Institute and K2, The Swedish Knowledge Centre for Public Transport, Sweden
[c] Lund University, School of Economics and Management, Sweden

ARTICLE INFO

Keywords:
Public transport
Mobility as a Service (MaaS)
Multilevel perspective (MLP)
Governance theories
Meta-governance

ABSTRACT

This paper examines governance responses to Mobility as a Service (MaaS). The analysis focuses on the interactions between public transport systems and MaaS developments in Amsterdam, Birmingham, and Helsinki. Case comparison is informed by the multilevel perspective on socio-technical transitions and literature on meta-governance of networks. Drawing on these frameworks and empirical findings, the paper identifies six governance approaches to MaaS across cases: analyser, architect, convener, experimenter, lawmaker, and provider. These basic models encompass strategies ranging from hands-on strong intervention to information collection efforts. Consistent with the transitions literature, these six approaches indicate that public transport regimes seek to control the apparent disruptive potential of MaaS by incrementally absorbing innovations; to this end, regime actors adopt governance responses that tend to reproduce existing institutionalised ways of doing and prevailing logics. Furthermore, the six approaches reveal intense interaction between regime and niche, suggesting that a niche-regime space might have emerged in the cases; actors travel and operate across niche, regime, and niche-regimes, mainly driven by concerns with market share and revenue streams in the mobility system.

1. Introduction

A small but rapidly growing body of literature analyses the emergence of Mobility as a Service ("MaaS") (Docherty et al., 2018; Lyons et al., 2019; Mulley, 2017). The MaaS proposition relies on a new service model that allows frictionless mobility based on the integration, in a single gateway, of multiple services currently offered in a fragmented fashion. From their smartphones, MaaS users should be able to plan, manage, and personalise multimodal door-to-door trips, paying for the whole journey in a single transaction. The MaaS rhetoric promises a future with seamless intermodality in the palm of customers' hands, ensuring the same freedom and convenience offered by cars, without the need to own one.

Despite the narrative's focus on customers' convenience, much of the agitation around MaaS is due to the opportunities and risks it poses to other actors and institutions in the mobility ecosystem (OECD, 2018). Yet, so far limited attention has been devoted to the repercussions of MaaS on metropolitan public transport ("PT")[1] (Hensher, 2017; Mulley and Kronsell, 2018; Smith et al., 2018). This

* Corresponding author at: Jaffalaan 5, 2628BX Delft, the Netherlands.
E-mail address: f.hirschhorn@tudelft.nl (F. Hirschhorn).

[1] The term public transport refers to all collective modes of land passenger transport services available to the general public within a metropolitan area, and linking it to its direct environment. There is no distinction based on ownership or control; these services can be either publicly or privately operated.

https://doi.org/10.1016/j.tra.2019.09.016
Received 7 January 2019; Received in revised form 9 September 2019; Accepted 11 September 2019
Available online 25 September 2019
0965-8564/

is relevant because behind the 'MaaS discourse', lies the promise of smarter policy-making and better management of PT supply and demand based on greater knowledge of users' behaviour. This, in turn, can support political ambitions on matters of sustainability, congestion, and use of urban space (Datson, 2016; Mulley, 2017; Parkhurst et al., 2012). Consequently, governments wish to steer a MaaS trajectory that favours multimodality with a prominent role for PT, whilst also avoiding solutions that discourage walking and cycling or increase car use.

However, whilst having similar interests, governments may choose different ways to deal with the Maas governance challenge. This paper analyses how public sector actors are responding to MaaS initiatives vis-à-vis the organisation and provision of PT, to identify and conceptualise current governance approaches to this innovation. The empirical focus lies on regional public transport authorities ("PTAs") and national ministries in Amsterdam, Birmingham, and Helsinki.

Methodologically and analytically, the paper responds to calls for more qualitative and mixed-method approaches in public transport research, and greater exchange with and use of concepts and methods from social sciences (Marsden and Reardon, 2017; Schwanen et al., 2011). The multilevel perspective on socio-technical transitions ("MLP") offers heuristic lens to structure the comparative design across three analytical levels: niches (silos for innovations), regimes (dominant established practices and associated rules), and landscape (the wider context in which niche and regimes are inserted) (Geels, 2002). According to the MLP literature, the land passenger mobility system contains multiple regimes, amongst which the car regime holds a dominant position (Geels, 2018; Parkhurst et al., 2012). The paper, instead, focuses on the PT regime and on its interactions with MaaS niches. Nevertheless, the MLP lacks adequate conceptualisation of actors' roles and strategies in transitions (de Haan and Rotmans, 2018; Wittmayer et al., 2017), so this analysis is complemented with literature on network governance, in particular meta-governance theories (Jessop, 2002; Koppenjan and Klijn, 2004; Sørensen and Torfing, 2009). Drawing on these two frameworks and on empirical material, the paper delineates six approaches being adopted in the governance of MaaS in the three cases: analyser, architect, convener, experimenter, lawmaker, and provider.

Section 2 introduces the MLP framework and the main concepts from governance theories used in the analysis. Section 3 describes methods and materials, whereas Section 4 presents case findings. The information in this section is organised across the MLP levels: first the landscape level, which is common across cases, and then PT regimes and MaaS niches (as defined in Section 2) of each case. Afterwards, Section 5 builds on previous sections to formulate six basic models of governance approaches to MaaS. Reflections and concluding remarks follow in Section 6.

2. Analytical framework

This section explains the main tenets of the MLP framework and of governance theories that are then employed as analytical framework for the paper's analysis.

2.1. The multilevel perspective and the socio-technical system of land passenger mobility

The MLP (Geels, 2002) is a widely used framework to address the adoption, diffusion or rejection of new technologies (Sovacool and Hess, 2017). The premise of the MLP is that transitions are processes that result from the interplay of developments at three analytical levels: landscape, regimes, and niches. Therefore, socio-technical systems, including the land passenger mobility system, respective events and actors, can be described and understood employing the MLP (e.g. Berkeley et al., 2017; Geels, 2012; Nykvist and Whitmarsh, 2008).

The landscape is the wider context constituted by exogenous elements that cannot be directly influenced by regime or niche actors, but that influence them through pressures that can either be of stabilising or destabilising nature. Examples of landscape factors include changes in demographics, cultural preferences, macro-economic or macro-political developments.

A series of current trends destabilise the land passenger mobility system, and are said to threaten the dominant position held by cars (Geels, 2018; Kingsley and Urry, 2009). Most notable amongst these trends, is the increasing concern with global warming, moving transport sustainability to the top of policy-making agenda (Banister, 2008; Marsden and Rye, 2010; Nykvist and Whitmarsh, 2008). In this context, a supranational entity as the EU can act as a 'landscape actor', able to generate destabilising pressures through regulation on emissions and strategies towards sustainable mobility (Hoffmann et al., 2017). In addition, authors also highlight pressures connected to the expansion of digitalisation and ICT, as well as sharing economy, that can modify individuals' preferences on how to travel (Geels, 2018; Meyer and Shaheen, 2017; Sperling, 2018). On the other hand, stabilising trends also exist. Geels (2018) suggests that neoliberal ideologies strengthen the current configuration of land passenger mobility by favouring the continued predominance of the car regime, as they resonate with the individualism and freedom associated with private cars. Along similar lines, Nykvist and Whitmarsh (2008) highlight stabilising trends supporting increased car use in Europe, such as growing incomes, greater participation of women in the labour force, and increases in speed and convenience of travel.

Regimes, in turn, represent the set of semi-coherent rules that orient and coordinate the activities of the social groups and that reproduce the various elements of socio-technical systems, such as shared beliefs, norms, standardised ways of doing; the concept can be applied to empirical topics of different scope (e.g. primary fuels or entire electricity systems) (Geels, 2012, 2011). Regimes are constituted by multiple dimensions, such as technology, regulation, user practices and markets, cultural meaning, and infrastructure (Geels, 2002; Geels and Schot, 2007). Small adjustments accumulating into stable trajectories across these dimensions promote incremental innovation in regimes. In this sense, regimes account for the (dynamic) stability of socio-technical systems. Furthermore, as *"socio-cognitive rules of routinized practice"* (Svensson and Nikoleris, 2018, p. 464), regimes reinforce prevailing logics and exert structuring force upon change processes (Fuenfschilling and Truffer, 2014; Smith et al., 2010). In this sense, a transition is defined as

the shift from one regime to another (Geels and Schot, 2007).

The land passenger mobility system contains diverse conceptually distinct regimes according to the transitions literature. The car regime is traditionally understood as a separate and dominant regime (Geels, 2018; Hoffmann et al., 2017; Sovacool and Axsen, 2018). This dominance is ensured through a series of stabilising factors and lock-in mechanisms, ranging from cultural values and the preference for the feeling of freedom promoted by ownership and individual transportation, to sunk investments in road infrastructure, car manufacturing plants, and important interests from diverse powerful players including car manufacturers and the oil industry (Geels, 2012; Sheller and Urry, 2000; Urry, 2004). Other modes of transport, on the other hand, constitute subaltern regimes according to literature. In relation to PT, some authors speak of subaltern regimes for each mode of transport (a bus regime, a train regime etc.), whilst others consider a broader secondary regime of public transport (Geels, 2012; Kemp et al., 2011; Parkhurst et al., 2012). Empirically, as parts of the wider land passenger mobility system, all these regimes maintain intense links (and, in fact, MaaS' ambition is to make passengers' experience seamless when using multiple transportation modes), but the conceptual differentiation is useful to delimit the scope of analysis in this paper: the focal regime analysed here is the broader PT regime, involving the provision of all collective modes of land passenger transport services available to the general public within a metropolitan area, and linking it to its direct environment. Following the general concept of regimes, PT regimes too comprise multiple dimensions: drawing on Geels (2018), Section 4 addresses the regime of each studied case by describing their main techno-economic developments, actors and institutions.

Finally, niches are protected silos for innovation, such as R&D laboratories and pilot projects. They provide the environment for testing and learning-by-doing. Through multiple experiments, and with support from influential groups, niche-innovations can gain momentum and *"…overcome the constraining influence of regimes, branch out, link up with wider change processes, and drive transformations in those same regime structures over the longer-term."* (Smith et al., 2010, p. 440).

The development of biofuels and electric vehicles are examples of niches in the land passenger mobility system (Geels, 2018, 2012). Geels (2012) also mentions tele-working and tele-shopping as components of ICT niches in personal mobility. Parkhurst et al. (2012) discuss intermodal personal mobility niches, analysing initiatives that allow the combination of multiple modes of transport in the same journey. This paper focuses on MaaS niches. MaaS is defined here as the business model based on offering passenger mobility services via a single platform, and integrated in at least three ways: (i) collection and organisation of information from various mobility offerings (public and private, collective and individual modes); (ii) combination of these offerings, as well as user input (trip customisation), for itinerary recommendation; and (iii) a single transaction allows booking and paying for the whole journey (Datson, 2016; Kamargianni et al., 2016; Mulley et al., 2018). The Maas niches analysed in the paper are those aiming to develop offerings to cover all these elements, not only part of them.

Despite being recognised as a key framework for analysing socio-technical transitions, the MLP has been criticised for an excessive focus on structures and lack of attention to actors' agency, politics, and power (e.g. Avelino, 2017; Smith et al., 2005). Hence, the MLP is unable to conceptualise actors' roles and interactions in transitions (de Haan and Rotmans, 2018; Wittmayer et al., 2017); the role of public sector actors, in particular, has traditionally been analysed implicitly in transitions literature, limiting the understanding of the state's nature and functions in these processes (Johnstone and Newell, 2018).

2.2. Complementing the MLP with governance theories

To tackle some of the limitations of the MLP, the paper employs governance theories. Broadly speaking, governance, and thus theories of governance, are concerned with creating and examining the conditions for ordered rule and collective action; the ways in which societies create and uphold rules and order in social processes in the pursuit of collective interests (Bevir, 2013; Peters and Pierre, 2016; Stoker, 1998). Analytically, the concept can be broken down into three distinct dimensions: politics (concerning the actor constellation, i.e. range of actors involved in the process of policy-making); polity (concerning the institutional landscape in which these actors operate); and policy (concerning political steering, i.e. the nature and character of steering instruments being used) (Treib et al., 2007). This paper emphasises the third analytical strand. It takes governance as every mode of political steering involving public and private actors, including traditional modes of government and different types of steering, from hierarchical imposition to sheer information measures (Héritier, 2002). The focus is on the interpretation of the interactions between the regime and niches to understand and conceptualise the governance approaches employed by public sector actors in relation to MaaS.

Therefore, the literature on the meta-governance of networks and meta-governors (Jessop, 2002; Koppenjan and Klijn, 2004; Sørensen and Torfing, 2009) constitutes a relevant source to support this study. Meta-governance refers to the role of the state and its instruments to initiate, support, and guide networks; the aim of this intervention is to ensure that networks, formed by governmental and non-governmental actors, contribute to the production of public value and to solutions for wicked policy challenges (Bevir and Rhodes, 2016; Koppenjan and Klijn, 2004). The legitimacy, special resources, and capacities of state actors give them a lead to act as meta-governors (Klijn and Koppenjan, 2000). They can mobilise knowledge and resources across the network whilst retaining the ability to influence the scope, process and outcomes of policy-making (Sørensen and Torfing, 2009).

Particularly relevant for this work is the typology of four forms of meta-governance developed by Sørensen and Torfing (2009): (1) *policy and resource framing* (limited and hands-off intervention to define the basic task of the network and the conditions for tackling this task, but without direct participation in the production of outcomes, as tasks are carried out by other network actors; (2) *institutional design* (strong hands-off intervention to determine the arenas for interaction between actors and the basic rules of engagement, thus influencing the scope, character, composition and procedures of the networks, but without a direct involvement in the execution of tasks); (3) *facilitation* (limited hands-on intervention, directly collaborating with the network and its activities to support process management and conflict resolution, lowering the transaction costs of interacting); and (4) *participation* (strong hands-on

intervention to influence the joint production of outputs and outcomes, aligning network activities with the governance ambitions pursued by the meta-governor). This framework depicts the possible ways in which public sector actors intervene in networks to achieve their political goals through varied steering tools, and even interacting directly with other network players through negotiations or by carrying-out tasks in certain circumstances. The typology can be useful to examine governance processes in the mobility sector (see e.g. Hansson, 2013) and thus to help address some of the weaknesses in the way the state has been examined so far in the MLP literature, supporting the analysis of responses to MaaS here.

3. Methods and materials

The paper takes a problem-driven research approach. It does not aim to test the theoretical frameworks discussed and their hypothesis to enable prediction and control, but to identify and conceptualise governance approaches to MaaS. These involve and are influenced by multiple interdependent actors and elements of different nature, like values, technology, and culture. This study, thus, requires concrete and context-dependent knowledge, and the qualitative case study method is well suited to this end (Flyvbjerg, 2006; George and Bennett, 2005; Guba and Lincoln, 1994; Yin, 2017). The paper employs the structured and focused comparison design (George and Bennett, 2005), and moves forward by asking the same questions from each case, focusing on those case elements defined according to the analytical framework presented in Section 2.

Consistent with the research aim and approach, case selection follows three main criteria. First, given that MaaS is a recent and still understudied phenomenon, the paper examines cases that can operate as reference points to highlight more general characteristics related to the governance approaches to MaaS. The objective is to use *"paradigmatic cases"* (Flyvbjerg, 2006) with prototypical value and strategic importance in relation to the general problem under examination. Helsinki is a front-runner in the development of MaaS, and thus can provide a longer history of events for investigation, whereas Amsterdam and Birmingham currently witness the development of relevant MaaS activities, but have yet received little attention from literature. Second, cases show diversity across defining elements of their PT regimes, thus contributing to the paper's goal of contrasting governance factors that might influence actors' approaches to MaaS: the three metropolitan areas vary in relation to the market share of PT, ticketing and fare policies, and display a diversified palette of governance setup in the sector. Third, case selection is guided by practical research considerations, such as availability of sources and familiarity with the cases' languages. The analysis is based on academic works, grey literature, policy documents, and interviews. Twenty individuals representing a varied set of stakeholders – PTAs, ministries, transport operators (public and private), user associations, and MaaS providers – were contacted for interviews, and sixteen agreed to collaborate (Appendix A). All evidence was collected during late 2018 (one interview conducted in 2019). Findings were triangulated to substantiate conclusions.

4. Empirical findings

To present the data collected from cases consistently, this section is organised across the MLP levels: first the landscape level, which is common across cases, and then PT regimes and MaaS niches (as defined in Section 2) of each case. The regime of each case, in particular, is described based on main techno-economic developments, actors and institutions.

4.1. The landscape for metropolitan land passenger mobility across cases

Interviewees and documents from the three cases tend to emphasise the same destabilising landscape trends discussed in Section 2.2, stressing the increased concerns around environmental degradation, and the spread of digitalisation leading to an "inevitable" move towards platform-based economies (e.g. interviewees A2, B1, Vervoerregio Amsterdam (2017) and HSL (2017a). Another reported trend is the decreasing interest of younger generations in owning cars, i.e. a growing preference for access to use over ownership, within a shared-economy environment (e.g. interviewees A1 and B4 or [Stadsregio Amsterdam, 2016]). Overall, there is a perception that these trends alter the way people wish to travel and their relationship with PTAs and operators. To be clear, whilst there is general agreement about main trends identified across cases, there is no consensus about the transformative potential of these trends. The rhetoric of MaaS developers that were interviewed suggests that a fundamental shift is in motion, whereas transport operators tend to air scepticism about chances of more profound changes. Opinions from other stakeholders are divided. Finally, whilst there is consensus about the hegemony of cars, interviewees did not highlight landscape stabilising trends and appear to take car dominance for granted and a permanent feature of the land passenger mobility system.

4.2. Amsterdam's PT regime

The market share of PT within motorised trips in Amsterdam moved from around 17% to 23% between 2006 and 2015. Cost-recovery levels grew in the same period, from 38% to nearly 50%. The monthly pass price in 2016 was €50.50, and the area's annual gross domestic product per capita in the same year was €34,700 (European Metropolitan Transport Authorities, 2018, 2017, 2009). Concerning funding, the national government is the primary source of PT subsidies through earmarked transfers to PTAs; these funds are used for operational costs and small infrastructure projects; meanwhile, the national government funds larger scale projects directly. PT subsidies are not indexed to inflation and have grown below this rate in recent years, creating important budget pressures in the sector. Ticket integration is guaranteed by a single nationwide smartcard valid across all PT modes and operators. The smartcard is managed by a joint-venture owned by all operators in the country. A national travel information system for PT exists

since the 1990s. The platform is managed by a cooperation between all PTAs and the Ministry of Infrastructure and Water Management ("Dutch Ministry").

Concerning main actors and institutions, the Dutch Law on Passenger Transport from 2000 decentralised PT planning responsibilities to regional authorities. Amsterdam's PTA plans and tenders concessions for bus, tram, and metro services in the city of Amsterdam and 14 surrounding municipalities. There are four concession areas: Zaanstreek, Waterland, Amstelland-Meerlanden and Amsterdam city. For each of these areas, a single operator is granted exclusive rights as provider of PT. The Amsterdam concession is directly awarded to the municipally-owned operator (GVB), whilst competitive tendering is used in the remaining areas. The concession contracts are net-cost, so all fare revenues – and thus the commercial risk connected to revenue fluctuation – are retained by operators. Coupled with this arrangement, operators have considerable freedom to design services; the PTA sets minimum requirements and maintains close dialogue with operators throughout the contract duration. Operators are also in charge of branding and ticket sales. Fare prices are the sum of a national boarding fee and a regional per-km fee set by each PTA. In addition to funding responsibilities mentioned above, the national government, through the Dutch Ministry, is responsible for the organisation of heavy rail services. The national railway company plans and operates intercity and regional trains.

4.3. Amsterdam's MaaS niches

Currently two main initiatives mark the development of MaaS in Amsterdam: the introduction of a MaaS proposition in the Amstelland-Meerlanden concession and a pilot project in the Zuidas business district. Although apparently territorially limited, both initiatives have a metropolitan scope as they involve travellers and transport networks that cross the borders of the concession or the neighbourhood.

The Amstelland-Meerlanden concession is the second largest in Amsterdam, and Schiphol International Airport is in this area. In 2016, the Schedule of Requirements for a new bidding of the concession acknowledges the emergence of new mobility options and behaviours enabled by new (uses of) technology, such as bike and car sharing, and integrated payment solutions (Stadsregio Amsterdam, 2016). The document asks for '*An operator that does not limit itself to 'its own' bus product, but also sees a role when it comes to improving pre- and post-transport in connection with 'its own' bus product, by optimising the connection to other (public) transport systems.*' (free translation). The document sets broad objectives and minimum requirements, leaving a lot of room for the operator to develop new services that respond to the new context. With MaaS, the PTA intends to respond to changes in users' interests on how to travel, seeking new ways to support PT ridership, increasing connectivity to enable regional economic growth, says interviewee A1.

The concession contract (2018–2027) was awarded to Connexxion. Their winning bid includes: the introduction of two MaaS platforms, Tranzer and Whim; AML Flex (on-demand taxi-like service adopting PT fares and smartcard); and agreements with shared-bikes companies. Tranzer, a Dutch app, offers, at the time of writing, single tickets for trips with the Dutch national railway company, GVB's trams and buses, and Connexxion's buses (in the case of GVB and Connexxion, drivers visually check smartphone tickets). Whim, the Finnish app from MaaS Global, is not active in Amsterdam yet. As explained by interviewees A5 and A7, metro stations are not equipped with turnstiles able to read QR code tickets (the technology required by MaaS Global). In addition, MaaS Global and operators have not yet reached a commercial agreement regarding ticket sales and pricing. Tranzer and MaaS Global want to be able to sell discounted multimodal and multi-operator tickets (and not only single tickets). However, operators resist opening up these for third party sale because they are subsidised tickets, explained interviewees A4 and A6. Moreover, there is no legal obligation for them to do so. One further controversial issue is the lack of agreement on how to share information about passengers' trips: privacy legislation prevents the opening-up of smartcard data on users' whole journey.

The Zuidas Pilot, in turn, originates from a specific concern from Amsterdam's municipality and firms located in the neighbourhood with congestion in the area. Due to major infrastructure works in the next ten years, the problem is expected to worsen substantially. In 2017 and 2018, the municipality conducted two small-scale experiments to test MaaS-like solutions (Zuidas Mobility Experience). They later sought financial support from the Dutch Ministry and Amsterdam's PTA to scale-up these initiatives

The Dutch Ministry, in turn, had already been interested in MaaS and, in 2016, commissioned a white paper 'Mobility as a Service' to set a definition for MaaS: *The provision of multimodal, demand-driven mobility services, offering customised travel options to customers via a digital platform (*e.g. *Mobile app) with real-time information, including payment and transaction processing* (MuConsult, 2017). This definition was complemented with a list of seven core functionalities, requiring, for instance, user's introduction of 'personal settings'; journey planning function; and ticketing and payment functionalities (Dutch Ministry of Infrastructure and Water Management, 2017). According to interviewee A2, from the ministry, The Netherlands must hurry to experiment with and define how to govern MaaS to avoid problems similar to New York's congestion associated to uncontrolled growth in ride hailing services.

The Dutch Ministry decided to organise and fund (for three years) seven MaaS pilots throughout the Netherlands, and Zuidas was included in this program. Amsterdam's PTA agreed to co-fund the project. The pilots will be tendered-out to consortia that can deliver a MaaS solution aligned with the Dutch Ministry's required definition and core functionalities. In late 2018, interested consortia entered into a Framework Agreement to qualify for the bidding of individual pilots in 2019. In parallel, the Dutch Ministry is negotiating a single standard API with car and bike sharing companies. This agreement could benefit all pilots, as MaaS providers would not have to negotiate separate contracts with each operator.

The municipality of Amsterdam and the Dutch Ministry are dealing more directly with the daily management of the Zuidas Pilot, but Amsterdam's PTA participates in frequent meetings with both. The PTA also convenes with operators to come up with a single offer in relation to ticket commercialisation that could be applied in the project. Interviewees from municipality, the PTA, and the Dutch Ministry highlight that the three parties maintain a good relationship and seek consensual solutions, but mention diverging preferences too. The Dutch Ministry has a strong interest in comparing results and maximising learning across the seven pilots. For

this, they need MaaS solutions to be relatively uniform, following their detailed definition and core functionalities. This, however, is not necessarily compatible with the municipality's interest in shaping their project to their own particular context. Whilst the Dutch Ministry starts from a common solution, the municipality wants to focus on the problem and allow room for the market to come up with a tailored response, points interviewee A3.

4.4. Birmingham's PT regime

PT's modal share within motorised trips in the West Midlands region has remained fairly stable in recent years, varying from 12% to 14% between 2006 and 2015. In 2015, the price of a monthly pass was €82.00, whilst the area's annual gross domestic product per capita was €23,536 Euro (European Metropolitan Transport Authorities, 2018, 2017, 2009). No data on cost-recovery ratios, comparable to similar information from Amsterdam and Helsinki, is available. Concerning funding, PT's operating budget comes mainly from the transport levy raised at the local level, which, however, is funded by UK's Central Government. These funds are used by local or regional authorities to pay bus operators for concessionary scheme tickets and a minor portion of PT services that is defined as socially necessary, as well as to fund other operational expenditure. In addition, all PT services in the UK receive subsidy through the Bus Service Operators Grant; in some areas, this is paid directly to bus operators whereas in others, such as Mayoral combined authorities, the local authority receives the payment and can decide how it is paid to bus operators. This grant was originally conceived as a fuel duty rebate, although it is no longer necessarily calculated on that basis. Local authorities may use these funds for other measures, such as encouraging operators to invest in smart card readers or in buses powered by alternative fuels. PT funding has been decreasing in recent years, generating budget pressures in the sector (Centro, 2014; House of Commons Transport Committee, 2019; West Midlands Combined Authority, 2018).

Passenger information (timetables and ticketing) is made available by Transport for West Midlands, the PTA, in partnership with local authorities and operators through 'Network West Midlands', which is also the common brand that identifies PT services. Swift, the smartcard managed by the PTA, is an important integration element in the relatively fragmented PT sector in the West Midlands. It offers multi-operator, multi-modal season tickets, and a pay-as-you-go scheme. The smartcard, however, co-exists with separate ticketing schemes managed directly by operators.

The West Midlands Combined Authority was established in 2016 based on the devolution agreement signed with the UK Government. The Combined Authority is responsible for, amongst other policy areas, PT strategy and policy. Within the Combined Authority, the PTA is the arm responsible for coordinating investments in West Midlands' (Birmingham and six surrounding municipalities) transport infrastructure, and to create a more integrated network. Buses carry approximately 80% of PT trips in the region. This market is deregulated and the provision of bus services, except for those deemed socially necessary, depends on operators' initiative. The PTA has limited planning roles and does not design services or fare policies for instance. Their involvement in these issues relies mostly on collaboration with market players. One example is the Bus Alliance, created in 2015. The Alliance is a collaborative initiative that gathers diverse stakeholders, including bus operators, the Combined Authority, local authority highways and transportation departments, and Transport Focus (users' watchdog) to discuss such topics as congestion, bus emissions standards, and ticketing. Besides bus services, the West Midlands have one tramline; its operation, previously franchised, has recently been taken over by the Combined Authority. In addition to its participation in funding PT, the Central Government, via the UK's Department for Transport ("DfT"), franchises heavy rail services. Concerning local rail, since 2017 services are jointly managed by DfT and a consortium formed by local authorities. This structure moves a step closer to a potential devolution of franchising responsibility.

4.5. Birmingham's MaaS niches

Since 2014, local authorities and the PTA (at the time called Centro) have been assessing the potential benefits that MaaS could deliver to personal mobility in the West Midlands. As highlighted in interviews, this interest emerged in the context of decreasing public funding for PT and, at the same time, general enthusiasm amongst politicians with the potential of technology to solve transport problems. Overall, MaaS was seen as a tool to improve PT ridership and the general economic environment. After commissioning a study on MaaS, the PTA obtained political support to develop these types of services in the West Midlands, without public funding though. Interviewee B1 recalls that two courses of action were considered. The first was to seek EU funding, but that would involve a long-term process with studies and trials to form conclusions about how to implement MaaS. The second option was to promote a business opportunity in the West Midlands, i.e. facilitate an environment in which interested parties could meet and develop MaaS projects. The second route was preferred.

In this context, the PTA and MaaS Global met. The start-up had recently been capitalised and was interested in showcasing their app, Whim, outside Finland, says B5. The PTA and MaaS Global signed a Memorandum of Understandings, also including other parties such as National Express (main operator in the region), and Transport Systems Catapult (a UK government not-for-profit technology and innovation research centre). This Memorandum constitutes a non-binding and non-exclusive commitment between the parties to collaborate to develop MaaS in the West Midlands, with the aim to ensure that MaaS is both commercially viable and supports societal goals, such as decreasing congestion and pollution. The Memorandum establishes general agreements in relation to data sharing: only data at the aggregate level, and no personalised or commercially sensitive information is shared. In relation to ticketing and pricing, MaaS Global and National Express entered into a separate agreement to regulate their business partnership. The PTA's main role has been to facilitate relationships in the fragmented context of West Midlands' PT regime.

The key distinctive feature of the Whim's offering in the West Midlands so far is the use of the smartcard Swift to commercialise

ticket packages. MaaS providers' preference, as seen in the case of Amsterdam, is to interact with clients only via smartphone. However, given the relative lack of integration in West Midlands' PT, both MaaS Global and the PTA opted for a different solution, as they were interested to go live as soon as possible with a minimally viable product, recalls interviewee B5. Irrespective of Whim, though, the PTA is moving towards greater payment integration. The Memorandum of Understandings is non-exclusive and the PTA continues to look for new partners and new initiatives: in 2018 some operators started accepting contacteless payment, Swift Mobile is expanding, and recently a pilot for the sale of tickets for the tram network via phone applications using Google Wallet was rolled-out. As in Amsterdam, there is no directive or regulation determining that operators need to open their tickets for sales by third parties though. Interviewee B1 believes that UK's government could intervene by developing a consensual code of conduct in relation to ticket (re)sale and pricing.

There was no direct involvement from DfT in these developments; they were nonetheless kept informed, indicate interviewees B1 and B2. More broadly, DfT joined MaaS4EU, an EU project in which the main goal is to provide quantifiable evidence, frameworks and tools to enable the MaaS concept. Moreover, the Department commissioned a study from Transport Systems Catapult on the potential of MaaS in the UK. Finally, in late 2018, DfT issued a call for evidence seeking information to support their Future of Urban Mobility Strategy. This Strategy is to be followed by a regulatory review process, consisting in further analytical work on forms of government intervention in new mobility services; whether and how the UK will regulate MaaS is still an open question, point interviewees.

4.6. Helsinki's PT regime

The share of PT within motorised trips and the cost-recovery levels in Helsinki are fairly high and stable over the years. Between 2006 and 2015, these ratios varied from approximately 38% to 40% and between 56% and 48% respectively. In 2016, the price of a monthly pass was €152.30, and the area's annual gross domestic product per capita €56.600 (European Metropolitan Transport Authorities, 2018, 2017, 2009). Differently from Amsterdam and Birmingham, PT funding comes primarily from the tax base of local authorities; municipalities transfer grants to the Helsinki Regional Transport Authority, the PTA, and negotiate the desired level of service. Ticketing in Helsinki is managed by the PTA; the system is fully integrated since the 1980s, and both a smartcard and tickets via smartphone application are valid across modes and operators in the metropolitan area (Helsinki, Espoo, Kauniainen, Vantaa, Kerava, Sipoo, Kirkkonummi, Siuntio and Tuusula). The PTA provides an online journey planner and makes schedule data available for third-party developers.

According to the Finnish Regional Development Act Helsinki's PTA is responsible for PT planning in the entire metropolitan area since 2010. The PTA plans and organises bus, metro, tram, and commuter rail services. Besides the responsibility for the general institutional setup of the sector, the Finnish State manages long-distance rail services. Municipalities, in turn, and in addition to funding operational costs, invest in some of the PT infrastructure, such as railway stations and terminals, being compensated for this by the PTA. As a result, local governments have important clout over PT, as highlighted by interviewee H1. All regional PT is contracted-out: bus services are competitively tendered, metro and tram services are procured from Helsinki's municipally-owned operator, and commuter rail services procured from the Finnish State Railways. Contracts between the PTA and operators are based on gross costs, so all fare revenues accrue to the authority that consequently retains commercial risks. As such, and differently from Amsterdam and Birmingham, it is Helsinki's PTA that develops detailed service design and plans, defining PT offering, routes and timetables. They are also responsible for the marketing of PT and for providing passenger information. The PTA also defines fare prices.

4.7. Helsinki's MaaS niches

The emergence of MaaS in Helsinki is the result of actions by both public and private players, with a decisive role for the former. Key actors are the Ministry of Transport and Communications ("Finnish Ministry"), the start-up MaaS Global, and Helsinki's PTA. ITS Finland, a non-profit association that includes private corporations, public agencies, and academic institutions has also been involved in initiatives supporting the early conceptualisation and promotion of MaaS.

At the national level, diverse strategy documents issued by the Finnish Ministry in recent years, such as the First and Second National ITS Strategies (2009 and 2013) and the Transport Revolution report (2011), emphasise an interest and need to develop ICT enabled solutions to enhance personal mobility. The documents aim to support more sustainable choices and challenge the use of private cars. They refer to door-to-door approach to mobility and the use of integrated payment methods.

These strategies were followed by a reform in the National Transport Act, voted by parliament in 2017. A central aim of the reform is to promote digitalisation of transport services and more efficient use of data, as part of the government's flagship project to create a growth environment for digital business. As stated by the Finnish Ministry, *"The aim is to create a favourable operating environment for digital services and new business models…"* (LVM, 2017). The role of government is limited to ensuring the proper functioning of free market forces: *"[i]nnovation and service platforms will be promoted in sectors where the public administration plays a role in terms of the functioning of the markets. Mobility as a Service is an example of such a sector."*. The reform of the Transport Act is organised in three stages. The first stage (2018) harmonises, under the Act, the provisions on road transport (PT, taxi, and freight), and establishes initial provisions on access to data. It requires transport providers to open their data related to routes, timetables, stops, and fares, as well as interoperability of ticketing systems via open APIs. The second stage (2019) enables further interoperability between different transport modes by organising all transport and traffic registers and data under one legislation, also including data about air, sea and rail markets in addition to road transport. Importantly, it determines that MaaS providers can access

season ticket's APIs on behalf of clients. The third stage concerns subsidiary issues, e.g. educational requirements for truck drivers, real-time data on heavy traffic, and emergency plans for logistic companies in case of major road and infrastructure accidents.

As government strategies developed, MaaS Global was founded, betting on a platform-based service to compete with car ownership; the company's vision, indicates interviewee H4, is that people are willing to pay for the freedom of mobility allowed by cars, hence this is where economic opportunities lie. By offering mobility services as packages based on consumers' needs, in a manner similar to the telecommunication sector, MaaS Global intends to provide travellers with alternative ways to make door-to-door trips that are as convenient as the car but less costly. Whim, MaaS Global's app launched in 2016, offers a pay-as-you-go option and two subscription packages with which users can access PT, taxis, and car rental in Helsinki. In the favourable context of Finnish legislative reforms, the fact that the Finnish Ministry regulates both transportation and ICT was a lucky coincidence, says H4. The company also counts on the knowledge and network of its founder and CEO, who was previously the CEO of ITS Finland and thus connected to discussions around MaaS since the inception of the concept. Furthermore, MaaS Global also counts on the support from the MaaS Alliance, an international network of influential players lobbying in favour of MaaS.

Helsinki's PTA, in turn, has not accompanied the national legislative changes and the development of Whim with enthusiasm at first, suggest interviewees H1 and H4. In 2016, the PTA agreed with the sale of single tickets via Whim (MaaS Global, 2016), but this meant a partial compromise only; a fully satisfactory solution to MaaS Global would have to include season tickets. By only selling single tickets, MaaS Global is not able to build a financially viable business model explained H4. First, this is inconvenient to users because even if they buy a monthly or unlimited subscription they still have to book single tickets for each trip. Second, MaaS Global pays the full price of these single tickets, whilst clients are paying a discounted fare via Whim (Audouin and Finger, 2018). The PTA justified its reluctance indicating that municipalities subsidise monthly passes and the authority must keep track of the place of residence of the passengers who buy them.

During 2017, the PTA conducted studies to evaluate the implications of the new Transport Act, MaaS' potential benefits and drawbacks, and the authority's possible role in this scenario (HSL, 2017a,2017b). These studies concluded that MaaS would be mostly in line with the PTA's mission, but that cooperation with MaaS providers would involve risks. Increasing their scope for action without guidance could drive customers away from PT, jeopardising sustainability goals and harming PT's finances. To mitigate these risks, the PTA could step in to create an urban mobility platform based on PT.

This last conclusion is a hint of what was to come; in 2018, amidst pressures connected to the new Transport Act's reforms already implemented or soon to be implemented, the PTA took actions towards further involvement with MaaS. They hired staff to work exclusively on MaaS, and introduced OpenMaaS "one of the world's first open retail interfaces for single tickets" (HSL, 2018a). Other initiatives that have a bearing on the expansion of MaaS include the procurement of frame contracts and of the "Idea Lab for New Mobility Services", both intended to develop new digital solutions to mobility challenges defined by the authority (including ride-sharing, leisure journeys, and solutions to reduce the need to travel) (HSL, 2018b, 2018c). Crucially, the PTA decided to include season tickets in OpenMaaS in late 2018 (Audouin and Finger, 2018).

5. Approaches to MaaS

By iteratively contrasting case findings with notions from the MLP and the meta-governance literature, the analysis now moves up a level from case description to formulate six basic models of governance approaches to MaaS: analyser, architect, convener, experimenter, lawmaker, and provider. These insights are then synthesised in Tables 1 and 2.

In Amstelland-Meerlanden, Amsterdam's PTA promotes the appearance of MaaS within the regular PT concession. The authority frames its perspective and goals related to MaaS in the concession's Schedule of Requirements, setting general policy objectives and guidelines of what it expects from bidders. MaaS, then, comes in the form of new (complementary) mobility services to be designed by the operator that, in turn, has freedom to design and implement its proposition within established policy and financial frames. This approach is here labelled *architect*; it is analogous to policy and resource framing characterised by Sørensen and Torfing (2009), based on limited and hands-off intervention. The architect does not have direct involvement in the execution of tasks to design and implement MaaS, but instead sets goals and frames policies and resources, whilst tasks are to be carried-out by other network actors (contracted-out), that have some leeway to do so. From the perspective of the MLP framework, the architect is thus a niche enabler and transitional actor (Geels and Schot, 2007), operating at the regime level. Concerning the Zuidas Pilot, Amsterdam's PTA maintains a limited degree of intervention, but their approach is more hands-on and facilitative in character. They wish to enable the niche by directly interacting with the network of actors to facilitate and mediate dialogue, and to seek mutually agreed solutions for an agreement concerning ticketing. By doing so, the PTA uses its influence to directly, and through a soft form, guide niche outcomes aligned with societal goals, thus without resorting to coercive steering. These features characterise the *convener* approach, analogous to the facilitation role defined by Sørensen and Torfing (2009). From the MLP point of view, the convener travels across and operates at regime and niche levels to enable niche activities.

In the same Zuidas project, the Dutch Ministry not only frames objectives, but also determines specific solution requirements: a MaaS definition and core functionalities must be observed across all pilots. As explained by interviewee A2, their main goal is to learn by doing, and pilots are used as living labs to provide lessons for a more informed definition of a long-term response to MaaS. This posture is eminently scoping in nature and, already from the outset, seen as a temporary: a more definitive role for government is to be defined after in-depth experience is gained with MaaS. In this role, the Dutch Ministry employs strong hands-on intervention, and uses its political influence and economic power to determine the direction of MaaS pilots. Tasks are to be carried-out by other network actors, moved by economic interests, but according to strictly defined guidelines. These characteristics form the approach labelled *experimenter*, that has no direct link with a particular meta-governance form defined by Sørensen and Torfing (2009). From

Table 1
Governance approaches to MaaS across cases.

Case	Actor	Approach	Analogous to	Operates at	Description
Amsterdam	PTA	Architect	Policy and resource framing (1)	Regime	Enables the niche with hands-off soft intervention to set broad goals framing policies and resources. Tasks are carried-out by other network actors (contracted-out) that have freedom to act within policy and financial frames.
		Convener	Facilitation (3)	Regime and niche	Enables the niche with hands-on soft intervention, using influence to help build relationships and networks. Supports and mediates dialogue and collaboration. Seeks mutually acceptable solutions. Relies on free market incentives for parties to come up with solutions, but ensures these are aligned with societal goals.
	Ministry	Convener	Facilitation (3)		(as described above)
		Experimenter	–	Regime and Niche	Enables the niche with hands-on strong intervention. The main aim is scoping via learning-by-doing. Seeks to maximise this using living labs as 'controlled experiments'. Tasks are carried-out by other network actors (contracted-out), but outputs follow detailed guidelines.
Birmingham	PTA	Convener	Facilitation (3)		(as described above)
	DfT	Analyser	–	Regime	Conducts scoping activities. Devolves responsibilities but seeks knowledge, collects evidence, and closely follows different initiatives to be equipped to intervene in free market if deemed necessary.
Helsinki	PTA	Provider	Participation (4)	Regime and Niche	Uses hands-on strong intervention. Mobilises resources to design and offer desired solutions ascertaining a position of leadership, i.e. maintaining/recovering original balance of power in a changing scenario.
	Ministry	Lawmaker	Institutional design (2)	Regime	Enables the niche with hands-off strong intervention. Regulation is the instrument to (re)design the system's institutional setup to allow market forces to drive innovation.

Table 2
Degrees of intervention across cases.

	Hands-on ⟷			**Hands-off**
Strong	PTA Helsinki (provider)	Dutch Ministry (experimenter)	Finnish Ministry (lawmaker)	
↕			PTA Amsterdam (architect)	
Soft	PTAs Amsterdam and Birmingham, Dutch Ministry (convener)			DfT (analyser)

Note: This comparison represents a relative measure specific to the cases analysed.

the perspective of the MLP, the experimenter intervenes directly at niche level by aligning actors' agenda and defining precise guidelines to determine the trajectory and outputs of the niche. In addition, but to a lesser extent, the Dutch Ministry also adopts a *convener* approach, manifested in their negotiations to facilitate the creation of a single API with bike sharing and car rental companies.

In Birmingham, the PTA acts to connect MaaS providers (initially MaaS Global, but also others possibly) and the PT regime (players like National Express). These parties are then able to establish a relationship and develop a business solution to implement MaaS. The Memorandum of Understandings, a non-binding and non-exclusive commitment, crystallises this collaborative and consensual approach. Ultimately, the PTA also relies on market incentives to drive actors interested in carrying risk in the pursuit of profit. By promoting relationships and a conducive environment, the PTA directly influences the niche's trajectory and outputs, to ensure that they are also aligned with targeted societal goals. Consequently, the PTA's governance approach to MaaS is also eminently that of a *convener*. Considering the MLP framework, thus, Birmingham's PTA is a niche enabler and transitional actor, operating at regime and niche levels.

DfT's approach to West Midlands' MaaS niche is marked by awareness and observation. Similarly to their posture towards some other MaaS initiatives, the Department shows interest in collecting evidence and learning from experiences in the UK and abroad. Within the UK's broader devolution agenda, DfT's interest is to equip government to choose if and how to govern the development of MaaS. Therefore, similarly to the Dutch Ministry, DfT adopts a predominantly scoping attitude. However, differently from the Dutch example, DfT's scoping is more hands-off and with no direct intervention in task implementation. DfT's approach is here labelled *analyser*, and is not analogous to any particular meta-governance form defined by Sørensen and Torfing (2009). From the standpoint of the MLP, the analyser is eminently a regime actor.

In Helsinki, in response to legislative changes, recent actions by the PTA involve direct hands-on intervention in the development of MaaS; they mobilised resources to design and offer desired solutions, including the hiring of dedicated staff to work with MaaS and the creation of OpenMaaS. This posture involves a movement of adjustment or re-orientation in a changing environment, with the aim to secure a leadership position in the PT ecosystem. Helsinki's PTA, intervenes directly in MaaS implementation and definition of outputs and this approach is here defined as that of a *provider*. The provider is analogous to the participation role defined by Sørensen and Torfing (2009), and considering the MLP, they operate both at regime and niche levels; they seek to restrain competition between niche solutions and regime (Geels, 2018).

Finally, the Finnish Ministry influences the development of MaaS through successive strategy documents supporting innovation in transportation, and, eventually, opting for a binding policy instrument – the new Transport Act. Whilst hands-off, leaving implementation of the Act to other actors, this intervention is strong due to its coercive and detailed prescriptions. The Act redefines the strategic institutional setup and the rules of engagement between actors in the PT ecosystem. Overall, this approach shows characteristics analogous to the role of institutional design proposed by Sørensen and Torfing (2009), and is here labelled *lawmaker*. From the perspective of the MLP, the Finnish Ministry restrains from direct involvement with implementation tasks or output production in the MaaS niche, operating and exerting power from the regime level.

6. Concluding discussion

This research is motivated by a concern with the scenario of agitation around, and limited understanding about MaaS and its potential implications for PT. To address this issue, the paper examines interactions between PT regimes and emerging MaaS niches, to understand and conceptualise initial governance responses to MaaS in Amsterdam, Birmingham, and Helsinki. Findings support the formulation of six basic models of governance approaches to MaaS appearing across cases, ranging from direct hands-on strong intervention in niches through participation in the provision of MaaS, to hands-off soft scoping via collection of evidence. Initial reflections on these findings follow.

6.1. Reproduction of practices from PT regimes

Despite the advertised novelty and disruptive potential of MaaS, responses from public sector actors in the three cases are consistent with the MLP's expectation that regimes tend to reproduce institutionalised practices in shaping or resisting to the

development of niches (Fuenfschilling and Truffer, 2014; Geels, 2014; Smith et al., 2010). In Amsterdam's PT regime, the PTA's main role is to set policy goals and to frame resources (defining minimum service requirements and the budget of each concession); the authority relies on tendering and contracting to guide their relationship with operators. The latter have a high degree of freedom to define service characteristics. This predominantly hands-off approach is combined, in certain moments, with close dialogue with operators to handle changes needed through the course of their contractual relationship. This is very similar to the architect and convener approaches being adopted by the PTA in relation to Amsterdam's MaaS niches. In the case of the Dutch Ministry, the picture is, for the moment, less simple, given their temporary approach to MaaS as experimenters. In the PT regime, they are directly responsible for providing commuter train services, but their participation is primarily marked by the strong and hands-off setup of the sector's overall institutional framework. This is done via legislative intervention (the Dutch Transport Act) and resources-framing (definition of total PT subsidy). This way, one might expect that once the national pilots are concluded, the Dutch Ministry will step-out of the niche and substitute the hands-on intervention for a more hands-off approach, similar to their regime practices. Interviews hinted at this, but there is yet no formal position on this matter.

Within the UK's deregulated bus sector (outside London), the PTA does not have the legal prerogative to initiate PT services, but, instead, has to rely on market forces to do so. Reforms, e.g. the 2017 Bus Act, increased the range of tools available to PTAs to influence planning and service delivery, however these tools are still limited when compared to other countries in Western Europe for instance. Whilst responsible for the definition of PT policy aims, West Midlands' PTA primarily relies on the ability to bring stakeholders together, promote dialogue, and support relationships across the system. The Bus Alliance is illustrative of this posture, that is also reflected in the convener approach to MaaS. In relation to DfT, the choice of a more hands-off approach in relation to West Midlands' MaaS niche could be interpreted as a reflection of a PT regime (and overall UK policy environment) increasingly characterised by the devolution of responsibilities to regional and local authorities. As in the case of the Dutch Ministry, interviews hint at a possible change in approach through the use of more formal regulation of MaaS initiatives in coming years, but this is uncertain now.

Finally, in Helsinki, the PT regime is strongly centralised around their PTA, that plans and organises all modes, including detailed service design, fare prices, payment and ticketing systems, branding and marketing. As such, Helsinki's PTA employs hands-on strong governance in PT, which is aligned with the provider approach they have recently taken in relation to Helsinki's MaaS niche. The PTA's reported initial reluctance towards MaaS could have been expected in this context: after years promoting branding and customer relationship efforts, the appearance of a MaaS intermediary threatening their direct link with passengers and individuals'travel information is plausibly undesired. Furthermore, the PTA's intention to develop their own MaaS solution – and thus secure the *status quo* of leadership in the provision of transport – could be an additional reason to be cautious about the uptake of Whim. The Finnish Ministry also maintains, in relation to Helsinki's MaaS niche, the same type of approach employed in the PT regime, marked by the setup of the institutional framework via legislation.

6.2. MaaS in the niche-regime space

The investigation shows that public sector actors, frequently portrayed as static regime players in transitions literature (Johnstone and Newell, 2018; Wittmayer et al., 2017), may also see the need to operate and exert power directly in niches. This could suggest that the studied MaaS niches might have 'broken the niche bubble' to more intensively interact with regimes. To be sure, this does not mean that MaaS is a fully viable and competitive solution to replace or substantially modify the PT regime, but that it gained considerable attention and it is no longer a niche-exclusive silo. This speaks to Avelino's definition of 'niche-regimes' as a space in which transformative power is exercised to develop new structures and institutions: *"While the regime is focused on reinforcing existing structures and institutions, and the niche is focused on developing new resources, there is a third type of 'space' in which actors are focused on developing new structures and institutions. Clearly, these three spaces are intertwined, and actors travel back and forth between and across them"* (2017, p. 510).

Moreover, whilst the six governance approaches show that actors might use various (or a mix of) of approaches depending on the context of their actions, overall governance responses acknowledge MaaS as a potential way to reach new PT demand and/or as a threat that could move PT ridership to other modes. This is, the intense interaction at a niche-regime space appears to be primarily driven by a concern with PT's market share and revenue streams. This concern is evident, for instance, in the challenges involving agreements for ticketing and data sharing. The governance approaches are mainly directed to adjust the regime so that MaaS can be incorporated and accommodated incrementally, in a synergetic rather than competitive way. Meanwhile, objectives connected to more sustainable mobility appear to be a secondary priority at the moment.

6.3. Research opportunities

The six governance approaches rely on a simplification of a more nuanced reality of complex interactions; other factors, such as different regime elements or simultaneous niche-innovations not emphasised here, might also be connected to emerging responses to MaaS. Importantly too, the six approaches are inspired by responses adopted within the context of specific cases and, thus, the same players might act differently in other situations. Finally, the paper focuses on public sector actors at regional and national levels, and does not analyse more deeply other relevant players, including car manufacturers and IT companies. Nonetheless, the scheme of governance approaches represents a first exploratory effort to fill a void in current literature that has few empirical studies about MaaS or its governance. These proposed approaches can be revised and enhanced, serving as a stepping-stone for future work on the same or different cases.

Importantly, this paper takes an initial step to allow coming work to address the extent to which early responses to MaaS set the stage for subsequent developments. In this sense, at least two complex questions emerge. The first question concerns the type of development trajectories these varied governance approaches may entail, i.e. the types of interaction between MaaS niches and PT regimes in the future. One way to look at this issue is to contemplate the alternative transition pathways defined in MLP literature, i.e. the different forms in which developments across the three levels of the MLP may occur in transition processes (Geels and Schot, 2007). By seeking to shape MaaS in a way that favours synergetic rather than competitive relations with the PT regime, public sector actors across cases attempt to steer pathways like *"transformation"* (under moderate landscape pressure, incumbent actors gradually adopt not sufficiently developed niche-innovations as add-ons to the regime) or *"reconfiguration"* (under landscape pressure, symbiotic niche-innovations are incorporated into the regime and, over time, with a sequences of component innovations, may cause substantial changes in the regime's basic architecture). A second related, and even more complex question, is whether and how the different governance approaches can influence the uptake of MaaS. The emerging literature prospecting the impacts of MaaS on travellers' behaviour shows that the potential effects and direction of changes brought by this innovation remain uncertain (see Durand et al., 2018 for a review). The empirics presented in Section 4 highlight that so far none of the public sector actors analysed in the paper has been able to find the governance response to tackle some critical challenges preventing a larger deployment of MaaS, such as issues of ownership and use of passengers' data or revenue sharing arrangements. Crucially, they also show that impasses around these issues have so far outweighed in importance the concerns with environmental degradation; the interest in using MaaS as a tool to drive more sustainable mobility appears to remain mostly circumscribed to discourse. Ultimately, governance alone might not be sufficient to explain the future path of MaaS, its uptake, and the results it delivers, representing just one of multiple explanatory factors.

However, it is perhaps too early to determine the extent to which initial governance responses can lead to desired trajectories or deliver positive outcomes (e.g. sustainable mobility goals). MaaS, as currently understood, is in its first years, whereas transitions are decades-long processes. Furthermore, and like other innovations in land passenger mobility, MaaS involves numerous actors across multiple commercial and non-commercial initiatives dispersed in time, space and speed of development. This complexity suggests that forms of command and control traditionally used in PT governance, such as tendering and contracting, might not be the most suitable response to achieve certain political objectives in the case of MaaS. In the age of smart mobility, smart governance might entail, instead, the need for meta-governors to combine existing and new practices, seek collaboration with a more diverse set of actors that possess various backgrounds and new and competing ideas, as well as engage in creative destruction of existing beliefs and practices to promote the development of new ones (Sørensen and Torfing, 2017). Importantly, public sector actors should be able to ensure that transport provision is guided by societal goals, rather than by the interest in commercialising users' data. A continued effort to build knowledge on the governance of MaaS is key to support decision-makers in this challenge.

Funding

This research was partially funded by K2, Swedish Knowledge Centre for Public Transport.

Declaration of Competing Interest

The authors have no competing interests to declare.

Acknowledgements

The authors are grateful for the feedback and suggestions provided by Didier van de Velde, the Journal's editor, and anonymous reviewers.

Appendix A. List of interviewees

Case	Code	Affiliation
Amsterdam	A1	PTA
Amsterdam	A2	Ministry of Infrastructure and Water management
Amsterdam	A3	Amsterdam Municipality
Amsterdam	A4	Transdev NL
Amsterdam	A5	GVB
Amsterdam	A6	Tranzer
Amsterdam	A7	MaaS Global Amsterdam
Birmingham	B1	PTA
Birmingham	B2	Department for Transport
Birmingham	B3	Transport Systems Catapult
Birmingham	B4	Transport Focus West Midlands
Birmingham	B5	MaaS Global West Midlands
Helsinki	H1	PTA
Helsinki	H2	Ministry of Transport and Communications
Helsinki	H3	OpenMaaS
Helsinki	H4	MaaS Global Helsinki

References

Audouin, M., Finger, M., 2018. The development of Mobility-as-a-Service in the Helsinki metropolitan area: a multi-level governance analysis. Res. Transp. Bus. Manag. 27, 24–35.

Avelino, F., 2017. Power in sustainability transitions: analysing power and (dis)empowerment in transformative change towards sustainability. Environ. Policy Gov. 27, 505–520.

Banister, D., 2008. The sustainable mobility paradigm. Transp. Policy 15, 73–80.

Berkeley, N., Bailey, D., Jones, A., Jarvis, D., 2017. Assessing the transition towards battery electric vehicles: a multi-level perspective on drivers of, and barriers to, take up. Transp. Res. Part A Policy Pract. 106, 320–332.

Bevir, M., 2013. A Theory of Governance. University of California Press, Berkeley and Los Angeles.

Bevir, M., Rhodes, R.A.W., 2016. The '3Rs' in rethinking governance: Ruling, rationalities, and resistance. In: Bevir, M., Rhodes, R.A.W. (Eds.), Rethinking Governance: Ruling, Rationalities and Resistance. Routledge, London.

Centro, 2014. Information about public transport expenditure in the West Midlands [WWW Document]. URL https://www.dudley.gov.uk/media/6666/centro-2014.pdf.

Datson, J., 2016. Exploring the Opportunity for Mobility as a Service in the UK. Milton Keynes.

de Haan, F., Rotmans, J., 2018. A proposed theoretical framework for actors in transformative change. Technol. Forecast. Soc. Change 128, 275–286.

Docherty, I., Marsden, G., Anable, J., 2018. The governance of smart mobility. Transp. Res. Part A Policy Pract. 115, 114–125.

Durand, A., Harms, L., Hoogendoorn-lanser, S., Zijlstra, T., 2018. Mobility-as-a-Service and changes in travel preferences and travel behaviour: a literature review. KiM Netherlands Institute for Transport Policy Analysis.

Dutch Ministry of Infrastructure and Water Management, 2017. Letter of Invitation to MaaS Market Consultation from November 2017.

European Metropolitan Transport Authorities, 2018. Barometer 2016.

European Metropolitan Transport Authorities, 2017. Barometer 2015.

European Metropolitan Transport Authorities, 2009. Barometer 2006.

Flyvbjerg, B., 2006. Five misunderstandings about case-study research. Qual. Inq. 12, 219–245.

Fuenfschilling, L., Truffer, B., 2014. The structuration of socio-technical regimes—Conceptual foundations from institutional theory. Res. Policy 43, 772–791.

Geels, F., 2018. Low-carbon transition via system reconfiguration? A socio-technical multi-level analysis of unfolding trajectories in Great Britain's passenger mobility system (1990–2016). Energy Res. Soc. Sci. 46, 86–102.

Geels, F., 2014. Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. Theory, Cult. Soc. 31, 21–40.

Geels, F., 2012. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. J. Transp. Geogr. 24, 471–482.

Geels, F., 2011. The multi-level perspective on sustainability transitions: Responses to seven criticisms. Environ. Innov. Soc. Transitions 1, 24–40.

Geels, F., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res. Policy 31, 1257–1274.

Geels, F., Schot, J., 2007. Typology of sociotechnical transition pathways. Res. Policy 36, 399–417.

George, A.L., Bennett, A., 2005. Case Studies and Theory Development in the Social Sciences. MIT Press, Harvard.

Guba, E., Lincoln, Y., 1994. Competing Paradigms in Qualitative Research. In: Denzin, N., Lincoln, Y. (Eds.), Handbook of Qualitative Research. Sage, Thousand Oaks, pp. 105–117.

Hansson, L., 2013. Hybrid steering cultures in the governance of public transport: A successful way to meet demands? Res. Transp. Econ. 39, 175–184.

Hensher, D.A., 2017. Future bus transport contracts under a mobility as a service (MaaS) regime in the digital age: Are they likely to change? Transp. Res. Part A Policy Pract. 98, 86–96.

Héritier, A., 2002. New modes of governance in Europe: policy-making without legislating? In: Héritier, A. (Ed.), Common Goods: Reinventing European and International Governance. Rowman & Littlefield, Lanham, pp. 185–206.

Hoffmann, S., Weyer, J., Longen, J., 2017. Discontinuation of the automobility regime? An integrated approach to multi-level governance. Transp. Res. Part A Policy Pract. 103, 391–408.

House of Commons Transport Committee, 2019. Bus services in England outside London: Ninth Report of Session 2017–19.

HSL, 2018a. HSL to make mobile tickets available via OpenMaaS sales interface on 2 April 2018 [WWW Document]. URL https://www.hsl.fi/en/news/2018/hsl-make-mobile-tickets-available-openmaas-sales-interface-2-april-2018-14846 (Accessed 10.15.18).

HSL, 2018b. HRT:s styrelsebeslut 6.3.2018 (HSL Board Decision) [WWW Document]. URL https://www.hsl.fi/sv/nyheter/2018/hrts-styrelsebeslut-632018-14719 (Accessed 10.15.18).

HSL, 2018c. HRT:s styrelsebeslut 29.5.2018 (HSL Board Decision) [WWW Document]. URL https://www.hsl.fi/sv/nyheter/2018/hrts-styrelsebeslut-2952018-15360 (Accessed 10.15.18).

HSL, 2017a. Liikenteen uudet teknologiat ja palvelut HSL Helsingin seudun liikenne. Helsinki.

HSL, 2017b. HSL:n rooli osana liikkumispalveluja. Tausta-aineisto lausuntopyyntöön [WWW Document]. URL http://hsl01.hosting.documenta.fi/kokous/2017476-2-2.PDF (Accessed 12.21.18).

Jessop, B., 2002. The Future of the Capitalist State. Polity Press, Cambridge.

Johnstone, P., Newell, P., 2018. Sustainability transitions and the state. Environ. Innov. Soc. Transitions 27, 72–82.

Kamargianni, M., Li, W., Matyas, M., Schäfer, A., 2016. A critical review of new mobility services for urban transport. Transp. Res. Procedia 14, 3294–3303.

Kemp, R., Avelino, F., Bressers, N., 2011. Transition management as a model for sustainable mobility. Eur. Transp./Trasporti Eur. 47, 25–46.

Kingsley, D., Urry, J., 2009. After the Car. Polity, Cambridge.

Klijn, E.H., Koppenjan, J., 2000. Public management and policy networks. An Int. J. Res. Theory 2, 135–158.

Koppenjan, J., Klijn, E.H., 2004. Managing uncertainties in networks: public private controversies. Routledge, London.

LVM, 2017. The Act on Transport Services implements Government Programme (Factsheet 64/2017).

Lyons, G., Hammond, P., Mackay, K., 2019. The importance of user perspective in the evolution of MaaS. Transp. Res. Part A Policy Pract. 121, 22–36.

MaaS Global, 2016. Helsinki takes another pioneering step in mobility services: HRT public transport added to the Whim mobility app [WWW Document]. URL https://maas.global/helsinki-takes-another-pioneering-step-in-mobility-services-hrt-public-transport-added-to-the-whim-mobility-app/ (Accessed 10.15.18).

Marsden, G., Reardon, L., 2017. Questions of governance: Rethinking the study of transportation policy. Transp. Res. Part A Policy Pract. 101, 238–251.

Marsden, G., Rye, T., 2010. The governance of transport and climate change. J. Transp. Geogr. 18, 669–678.

Meyer, G., Shaheen, S. (Eds.), 2017. Disrupting Mobility: Impacts of Sharing Economy and Innovative Transportation on Cities. Springer, Cham.

MuConsult, 2017. White Paper Mobility as a Service.

Mulley, C., 2017. Mobility as a services (MaaS)–does it have critical mass? Transp. Rev. 37, 247–251.

Mulley, C., Kronsell, A., 2018. Workshop 7 report: the "uberisation" of public transport and mobility as a service (MaaS): implications for future mainstream public transport. Res. Transp. Econ. 69, 568–572.

Mulley, C., Nelson, J.D., Wright, S., 2018. Community transport meets mobility as a service: On the road to a new a flexible future. Res. Transp. Econ. 69, 583–591.

Nykvist, B., Whitmarsh, L., 2008. A multi-level analysis of sustainable mobility transitions: niche development in the UK and Sweden. Technol. Forecast. Soc. Change 75, 1373–1387.

OECD, 2018. Blockchain and Beyond: Encoding 21 st Century Transport. Paris.

Parkhurst, G., Kemp, R., Dijk, M., Sherwin, H., 2012. Intermodal personal mobility: a niche caught between two regimes. In: Geels, F.W., Kemp, R., Dudley, G., Lyons, G. (Eds.), Automobility in Transitions? A Scio-Technical Analysis of Sustainable Transport. Routledge, pp. 308–334.

Peters, B.G., Pierre, J., 2016. Comparative Governance: Rediscovering the Functional Dimension of Governing. Cambridge University Press.

Schwanen, T., Banister, D., Anable, J., 2011. Scientific research about climate change mitigation in transport: a critical review. Transp. Res. Part A Policy Pract. 45, 993–1006.
Sheller, M., Urry, J., 2000. The city and the car. Int. J. Urban Reg. Res. 24, 737–757.
Smith, A., Stirling, A., Berkhout, F., 2005. The governance of sustainable socio-technical transitions. Res. Policy 34, 1491–1510.
Smith, A., Voß, J.P., Grin, J., 2010. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. Res. Policy 39, 435–448.
Smith, G., Sochor, J., Karlsson, M., 2018. Mobility as a Service: Development scenarios and implications for public transport. Res. Transp. Econ. 69, 592–599.
Sørensen, E., Torfing, J., 2017. Metagoverning collaborative innovation in governance networks. Am. Rev. Public Adm. 47, 826–839.
Sørensen, E., Torfing, J., 2009. Making governance networks effective and democratic through metagovernance. Public Adm. 87, 234–258.
Sovacool, B.K., Axsen, J., 2018. Functional, symbolic and societal frames for automobility: implications for sustainability transitions. Transp. Res. Part A Policy Pract. 118, 730–746.
Sovacool, B.K., Hess, D.J., 2017. Ordering theories: Typologies and conceptual frameworks for sociotechnical change. Soc. Stud. Sci. 47, 703–750.
Sperling, D., 2018. Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future. Island Press.
Stadsregio Amsterdam, 2016. Programma van Eisen Concessie Amstelland-Meerlanden 2018.
Stoker, G., 1998. Governance as theory: five propositions. Int. Soc. Sci. J. 50, 17–28.
Svensson, O., Nikoleris, A., 2018. Structure reconsidered: Towards new foundations of explanatory transitions theory. Res. Policy 47, 462–473.
Treib, O., Bähr, H., Falkner, G., 2007. Modes of governance: Towards a conceptual clarification. J. Eur. Public Policy 14, 1–20.
Urry, J., 2004. The 'System' of Automobility. Theory, Cult. Soc. 21, 25–39.
Vervoerregio Amsterdam, 2017. Beleidskader Mobiliteit. Amsterdam.
West Midlands Combined Authority, 2018. Expenditure in the West Midlands 2018-19 [WWW Document]. URL https://www.wmca.org.uk/media/2190/expenditure-leaflet-2018.pdf.
Wittmayer, J.M., Avelino, F., van Steenbergen, F., Loorbach, D., 2017. Actor roles in transition: insights from sociological perspectives. Environ. Innov. Soc. Transitions 24, 45–56.
Yin, R., 2017. Case Study Research and Applications: Design and Methods, sixth ed. Sage Publications.