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Pangbourne, K. (2020) Challenge, Coordination, and Collaboration for Effective Rural Mobility Solutions. Chapter 4 in *Implications of Mobility as a Service (MaaS) in Urban and Rural Environments*. Eds: Amaral, A. M., Luís Barreto, L., Baltazar, S., Silva J. P., and Gonçalves, L. IGI Global, ISBN13: 9781799816140

INTRODUCTION

An integrated approach to transport has been an objective of transport policy for many decades but it has yet to be fully realized. The emergence of Mobility as a Service or MaaS (a concept describing a set of characteristics for tools to access mobility) has been promoted as being the long-awaited enabler for such integration. MaaS itself is in turn facilitated by the increasing pace of digitalization of daily life. However, we are still in the early part of a hype cycle for MaaS, as is suggested by Eckhardt et al., (2018) for example. Therefore, it is timely to critically interrogate claims made for MaaS proposals before committing ourselves to a future reliance on MaaS for delivering public benefits.

In this chapter the author critically examines two of the promises made by promoters of MaaS which are important to supporting accessibility and reducing transport's environmental impacts, namely integration and efficiency. The author goes on to consider how these promised visions might play out when applied to rural settings. The objective is to show that MaaS tends to be presented as a universal remedy, but that there are different potential impacts for urban versus rural contexts. Some of these potential impacts have social and distributional implications, even though it is clear that there is evidence for the potential benefits of more flexible approaches to rural public transport. Without clarity of thinking, these differences pose a significant challenge for 'rural MaaS' because a key aspect of the development of MaaS is founded on a value proposition designed for urban conditions. Each aspect of the challenge, and alignment with current policy trends in relation to MaaS is discussed in section four and some solutions and recommendations are offered in section five. Firstly however, section two sets out the theory and method used to develop this argument, and section three provides a background to MaaS, particularly its definitions, evolution and the context of the main rural challenges. The chapter ends with an assessment of future research directions (section six), and a closing summary.

THEORETICAL PERSPECTIVE AND METHOD

In this chapter the author argues that challenge to be addressed by MaaS differs between rural and urban settings. The objective is to show whether the potential for MaaS to benefit rural areas could be undermined by unanticipated outcomes from MaaS if too much trust is placed on the current claims regarding MaaS. These claims tend to either be aspatial (ignoring geographic factors) or they specifically refer to urban issues. Furthermore, these claims tend to be biased to being pro-MaaS, as rhetorical persuasion is identified as an important mechanism in how new technologies are taken up in society, by controlling the public discussion around what challenges technological solutions such as MaaS are intended to address (Berkhout, 2006).

Pangbourne, Stead, Mladenovic and Stead (in press) have closely examined this type of rhetoric in relation to the governance challenges posed by MaaS. This chapter carries out a similar exercise in relation to issues specific to rural settings. The author asked the research question "What are the priorities that need to be addressed in defining objectives for rural MaaS?" This question is addressed through a synthesis of facts about the current state of MaaS development, with a qualitative analysis of MaaS promotional and information documents to understand the degree to which rural areas are specifically addressed, followed by a consideration of rural need in light of seven core characteristics of MaaS (Jittrapirom et al., (2017) see below). This

argument is underpinned by the background section which surveys academic literature about rural issues, including transport.

The method uses purposive and inductive documentary analysis. Grant (2018) defines documents as texts that can exist in either electronic or physical form. Document types include tweets, social media posts, interview and focus group transcripts, archive material and published documents of many types. Such documents can be created as part of the research process (primary data) or can be already existing (secondary data). This chapter uses existing documents about MaaS sourced using the internet (search terms Mobility as a Service, MaaS, rural AND MaaS, rural AND Mobility as a Service), and in the English language. Academic and factual sources are reviewed in the usual way, before a set of important MaaS promotional documents are analysed for their content relating to the application of MaaS to rural areas.

BACKGROUND

This section discusses the definitions and origins of MaaS. It then briefly covers the current state of deployment and the role of coalitions created to promote the interests of those with something to gain from promoting MaaS as a universal solution for integrating transport services. The different transport and societal characteristics of rural compared to urban settings are also outlined in order to inform the argument that is put forward in the rest of the chapter. Whilst there has been a rapid increase in the quantity of material published on MaaS, this is not an overarching review, as others have already done this (e.g. Utriainen & Pöllänen, 2018). Therefore, work included here has been selected specifically to address questions raised by the position put forward in this chapter.

Genealogy and definition of Mobility as a Service

MaaS is a relatively new term in the world of transport, which is often credited in part to a Masters' thesis in Finland (Heikkilä, 2014). Aapaoja, Eckhardt, Nykänen, and Sochor (2017) point out that the typical characteristics of products described as MaaS are that they have a one-stop-shop principle. In other words they provide for mobile ticketing and payment, and include information to allow users to plan multimodal journeys and rerouting. However, others have shown that some key aspects of MaaS a very similar to earlier transport ideas, such as Advanced Traveller Information Systems (Lyons, Hammond & Mackay, 2018), which was promoted in the 1990s as an essential element in the integration of different transport modes which empowered users in planning and re-planning journeys themselves. Clearly the intermodal and multi-service provider aspect of completing an end-to-end journey is not entirely novel (Utriainen & Pöllänen, 2018; Hensher, 2017).

However, there is some novelty in personalization to individual preferences (such as desired travel time, pro-environmental values, cost, and accessibility requirements) as well as in the use of mobile apps as the primary user interface for booking and payment. In the servitized model first set out by Heikkilä and since promoted heavily by MaaS Global there is a user registration requirement for full access to the product features, and there is very often a monthly subscription package. This aspect of the business model delivers an additional value proposition and a new source of profit, as registered users generate a lot of data that has the potential to be used for service planning, traffic forecasting and urban management. The type of data generated by a

MaaS platform is therefore an important commodity when combined with new data analysis capabilities.

Many of these features (such as the development of new sources of data), were found pre-2014 in schemes and projects that aimed to either increase the use of sustainable mobility modes, such as UbiGo (Karlsson, Sochor & Strömberg 2016) and Superhub (Forbes, Wells & Masthoff 2012) or to increase the efficiency of routing and mode choice such as the personalized multi-modal journey planner and interface built for MyWay (Pou, 2015). These projects which sought to achieve more sustainable *urban* mobility through the use of digitized coordination can be viewed as prototypes on the way to the current form of MaaS (see for example Sochor, Strömberg & Karlsson, 2015).

Digital innovation is generally seen as an opportunity for economic development. As a resultMaaS has come to be seen as a growth area, and many public-private coalitions are emerging to build the case for MaaS and unlock government action and investment. Table 1 surveys a range of definitions of MaaS that are in current use by such coalitions. Most of these definitions owe much to Heikkilä (2014) and the subsequent promotional efforts of a Finnish company (MaaS Global) that has captured the policy imagination, particularly in Europe (Pangbourne et al., 2019).

Table 1 A selection of MaaS definitions in current use in Europe and beyond

Where	**Who**	**Definition**
Australia	Mobility as a Service Australia	*Mobility as a Service (MaaS) is all about you – providing you with personalised mobility solutions that make use of this wide range of mobility options. Mobility as a Service brings every kind of transport together into a single intuitive mobile app. It seamlessly combines transport options from different providers, handling everything from travel planning to payments. (http://maasaustralia.com/)*
Catalonia	MaaS Catalonia	*Mobility as a Service is a user-centric, intelligent mobility distribution model in which all mobility service providers' offerings are aggregated and supplied to users through a single digital platform.*
Europe	MaaS Alliance	*the integration of various forms of transport services into a single mobility service accessible on demand. To meet a customer's request, a MaaS operator facilitates a diverse menu of transport options, be they public transport, ride-, car- or bike-sharing, taxi or car rental/lease, or a combination thereof. (https://maas-alliance.eu/homepage/what-is-maas/)*
Finland	ITS Finland	*A mobility distribution model in which all of a customer's major transportation needs are met from a single platform*

		by a single service provider that orchestrates each individual transport service component to meet a customer's end-to-end service expectations. Typically, services would be bundled in to a package similar to current mobile operator services. (https://www.its-finland.fi/index.php/en/palvelut/mobility-as-a-service.html)
The Netherlands	Ministerie van Infrastructuur en Milieu, citing the White Paper 'Mobility as a Service' by MuConsult (2017)	*the provision of multimodal, demand-driven mobility services, whereby customers are offered tailor-made travel options via a digital platform (e.g. Mobile app) based on real-time information, including payment and the handling of transactions.*
UK	Parliamentary Transport Committee	*MaaS is the term for the digital platforms (often smartphone apps) through which people can access a range of public, shared and private transport, using a system that integrates the planning, booking and paying for travel.* (House of Commons, 2018, p3)

There are differences between these definitions which can cause confusion. Jittrapirom et al., (2017) have identified a dozen conceptualisations of MaaS. They extrapolated from these a set of nine core characteristics: integration of transport modes; tariff option; a single platform; multiple actors; use of technologies; demand orientation; registration requirement; personalization; and customization, the first seven of which are used in this chapter to frame a set of requirements for rural MaaS.

MaaS focal points: urban areas, efficiencies and a commoditized value proposition

In relation to MaaS, most government and commercial focus has concentrated on urban developments, something that fits well with the Smart Cities paradigm which attracts a lot of investment. Whilst it is beyond the scope of this chapter to explore Smart Cities, it is useful to note that Hollands (2008) describes Smart Cities as consisting of using "networked infrastructures to improve economic and political efficiency and enable socio, cultural and urban development" (p. 307). Transport is one of the central pillars of the movement but there is nothing comparable for rural areas, even though rural areas are equally deserving of social and cultural development and would benefit from networked infrastructures.

This and other urban transport issues are important policy drivers that are harnessed to much rhetoric around transport innovation, including the claim of MaaS promoters that their model provides an efficient solution to congestion and sustainability, by enabling public transport to be supported by other traditional and innovative transport modes. At the same time, they promote MaaS as a benefit for end-users by making all forms of transport easier to use through a single

interface (i.e. reducing the cognitive load involved in travel mode choice (Stradling, Hine & Wardman, 2000).

This idealized claim that MaaS improves the efficiency of transport leads to it being presented as the epitome of 'shared mobility'. Shared mobility is a term covering a number of forms of vehicle or ride-sharing, which is promoted as improving efficiency. It is not necessary to go further into it for the purposes of this chapter, though Le Vine and Polak (2015) is a place to start for interested readers. They also link shared mobility to the sharing economy, with both ideas generally perceived as underpinned by Information and Communications technology (ICT). Rhetorically of course 'sharing' is perceived as a virtue, so to link it to MaaS is to make MaaS sound virtuous by association. However, it has been pointed out by Bardhi and Eckhardt (2012) that the 'sharing economy',, is not communitarian but commercial, with the promoted value proposition being more driven by commodifying and monetizing access to transport than by pro-social values of sharing systems supporting reciprocity and social connection. Thus the profit-motive will seek either to increase mobility when it more properly ought to be reduced for many people if transport's negative impacts are to be addressed (particularly climate change) or to make current levels of mobility more expensive once a market is captured, which would be undesirable for those who already suffer a mobility deficit due to poor affordability, or where transport costs are already higher, such as in rural areas. Therefore there are grounds for not assuming that MaaS will be a) virtuous or b) efficient in addressing congestion and other negative impacts associated with excess or lack of transport, even in urban settings.

Rural contexts

Having established that the focus of innovation attention is on larger cities, this potentially leaves substantial land areas, and their residents, neglected. To take the United Kingdom (UK) as an example, there are several areas that are classed as rural. Within Scotland, for example, most of the Highlands and Islands region is classified as Remote Rural, which are defined as areas with a population of less than 3,000 people, and with a drive time of between 30 and 60 minutes to a Settlement of 10,000 people or more (Scottish Government, 2018). Other areas with similar characteristics within the UK include Wales, Cumbria and Cornwall. English, Scottish and Welsh rural areas are facing the challenge of an aging population - 60% of the English and Welsh rural population are over 45 years old (ONS, 2018). In Wales, the number of people aged 65 and over is projected to increase by 36.6 per cent between 2016 and 2041 (ONS, 2017) and about one-third of the Welsh population live in rural areas (Gartner, Gibbon & Riley, 2007). In a wider context, most European countries have substantial areas that may be classed as some variety of rural. The next section explores the characteristics of rural areas that make them distinctive in terms of transport provision.

CHARACTERISTICS OF RURAL AREAS

What many rural areas in developed nations have in common is that communities are generally facing an older but smaller population. The shrinking and ageing of rural populations is related both to general demographic trends with increased longevity combined with lower birth rates as well as to a continued loss of young people who 'self-urbanise' to seek higher education or employment (Amcoff & Westholm, 2007). The effect is to lead to difficulties in maintaining public services, brining into question the long-term sustainability of rural areas. Whilst living in rural areas is sometimes framed by policy makers as a lifestyle choice that carries with it the

need to trade-off certain expectations, this is a skewed perspective that is drawn upon to justify the closure and centralization of public services (e.g. Woods, 2006; Van Steen & Pellenbarg, 2010). For many countries rural regions will remain important for their primary industries, as settings for leisure and tourism and as managed (to greater and lesser extent) habitats providing critical ecosystem services. Therefore, there will remain a need for a rural workforce, which will live, work, raise families and retire there. This population will need mobility and their requirements will vary over the course of a life, yet the challenge of organizing public transport in rural areas is a long-recognised and increasing issue that is compounded by highly individualized solutions based on an increased reliance on personal vehicles.

Against this background rural MaaS needs to address specifically rural challenges arising from the combination of lower population densities with sparser transport networks, patchy ICT infrastructure, the accessibility requirements of older people, and supporting the continued societal need for the products of rural industries. This is itself a challenge as the requirements for supplying the mobility needs of rural livelihoods are quite different in many ways from the needs of the retired rural population. These challenges are summarized and represented visually in Figure 1.

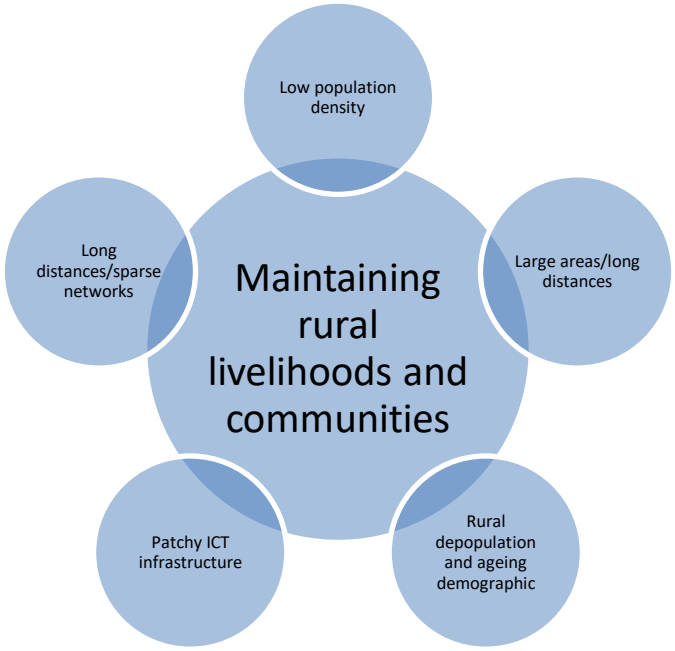

Figure 1 The rural MaaS challenge

In this section, each of these challenges and their rationale are described in turn, and the section ends with a discussion of how these issues are addressed in the typically positive MaaS rhetoric.

The challenge of sparse populations and transport networks

Large areas and low-density populations are defining features of rurality. Mobility-related consequences of this are sparse transport networks and the need to cover long distances.

Employment related consequences are a preponderance of primary industry or jobs based on the natural environment in some way.

Liimatainen and Mladenović (2018) highlight that public transport is the backbone of every MaaS offering thus far, so there is clearly a challenge to resolve for rural MaaS, where public transport has been tending to contract for several decades. Surakka, Härri, Haahtela, Horila and Michl (2018) highlight that Finland, for example, has a very low level of rural public transport provision which has led to a high degree of dependence on private cars, and they contrast this with the provision in Switzerland, in which an integrated system is delivered between the railways and the Postbus network which have closely coordinated timetables. However, the rural geographies and infrastructure of these two countries are not very comparable.

Whilst it is unlikely that all the developments that have been afforded to urban areas can be transferred to rural areas, delivering better accessibility more sustainably is essential in order to support the continued attractiveness of these areas as working landscapes where people will need to live in the future. Eckhardt et al., (2018) highlight that it is recognized that *mobility challenges are not only restricted to cities, as they also concern social inclusion and the connectivity of rural areas* (European Commission, 2017), yet most of the investment and attention thus far is centred on high density cities with a plurality of transport modes potentially available for integration within a MaaS ecosystem. It is also more challenging to address transport decarbonization in rural areas (Sovacool, Noel, Kester & de Rubens, 2018).

Additionally, something that is often left out of MaaS visions is non-passenger mobility. Some disruptive innovators impacting on the transport sector and urban environment certainly do keep aspects of logistics in their sights through short-lived experimental pilots or more established services (for example Uber, Deliveroo, or JustEat), but it is not a strong element in most material on MaaS, as passenger and freight have been largely separated in recent decades, though postbuses and parcels sent by passenger rail were standard in the past and the MaaSiFie project included rural logistics in its study (Eckhardt et al., 2018).

Under-served and ageing demographics

It is well documented that there is an undeniable need for socially disadvantaged groups (e.g., older adults, young, and disabled) in rural and remotely located areas to be better served in relation to their mobility requirements (Currie, 2010). Delivering better rural accessibility more sustainably is a difficult challenge in relation to the ageing population. Health and gerontology research has established that out-of-home mobility is a significant component in maintaining physical health and mental well-being in old age. As having a driving licence and access to a car has become a significant predictor of higher overall mobility in our automobile-oriented society, loss of that access, through impairment to driving ability can have significant ill effects (Zeitler & Buys, 2015). For example, Marottoli et al., (2000) found a strong association between driving cessation and decreased out-of-home activity.

In a highly car dependent society, a lack of alternatives to driving leads to transport disadvantage amongst older adults (Engels & Liu, 2011), yet older adults now expect increased mobility compared to previous generations (Alsnih & Hensher, 2003) and may not plan for the possibility of driving cessation in retirement (Musselwhite & Shergold, 2013). Most focus has been on

technological means of extending independent safe driving in private cars for longer (Nordbakke & Schwanen, 2015), rather than on providing other means of transport, such as demand responsive public transport (DRT), even though DRT models for public transport were demonstrated as feasible for rural areas several decades ago.

For rural areas, there is the added issue of the centralization of essential services, as discussed in the previous sub-section above, resulting in a need to consider the demand for all people, including older citizens, to travel beyond their local area for essential purposes (Ruyser & Halseth, 2012). A non-transport response to that has been an exploration by the health sector and health service researchers of care-at-a-distance via ICT, but that has not yet matured, and acceptance by the public of the need to engage with technology in order to access services has been proceeding more slowly outside metropolitan areas (Currie, Philip & Roberts, 2015). This is partly due to ICT connectivity issues in rural areas, but the characteristics of older demographics are undoubtedly a factor.

Whilst there is a cohort effect in that subsequent generations of older people will have more ICT skills and positive attitudes, these are modified by cognitive and physical impairments resulting in interface accessibility issues as well as the continual advance of ICT beyond existing users' abilities (e.g. Pangbourne, Aditjandra & Nelson, 2010). There is also a valid critique arising from the Smart Cities debate about the 'disciplining' of individuals through the increased 'forcing' of technological adoption (e.g. Vanolo, 2014), that would be applicable to rural MaaS as much as to the Scottish Government's insistence on a wholesale shift to smartcard ticketing or the Swedish move to become a cashless society. A more detailed discussion of this aspect of MaaS is needed but outside the scope of this chapter.

However, the issue of a lack of coordination between different policy sectors is a significant barrier to providing a better level of mobility in rural areas. Pangbourne et al. (2010) highlight the lack of coordination between the health service and public transport realities in setting appointment times for example, and there is also no coordination between transport organized and provided by the healthcare system with other socially necessary transport services, probably resulting in more vehicle movements than strictly necessary for the level of population mobility supplied. Better coordination between *sectors* is similarly a key recommendation of Eckhardt et al. (2018), and rural MaaS is potentially an ideal candidate for this type of coordination.

Limitations of Rural Information and Communications Technology Connectivity

Given the role of ICT in enabling MaaS, which is sometimes portrayed as the ultimate form of demand responsive mobility, the questions of adoption and acceptability cannot arise until there is availability. As noted above, ICT is not ubiquitous in rural areas, yet it is a key enabler for MaaS, and adoption of MaaS applications requires familiarity with mobile interfaces. The potential for MaaS to open a new front in digital exclusion has been highlighted by others (for example Sochor and Nikitas (2016). For example, Polydoropoulou, Pagoni and Tsirimpa (in press) carried out stakeholder and end-user research in the Greater Manchester region (UK), and found that low levels of digital take up and low trust in digital payments are social barriers to MaaS implementation, and that poor internet coverage is both a social and operational barrier. For example, in terms of socially disadvantaged groups, it was recognized that the 'unbanked'

would not be able to access MaaS services, and this was rated as a strong operational barrier. The results of their workshops in Budapest (Hungary) were substantially the same.

If these are barriers in highly urbanized areas, then the prospect for rural areas is unlikely to be more favourable. Rural areas have long been a focus of attention for academics interested in social inclusion due to transport connectivity issues and more recently ICT has been added to the list of issues. See Nutley (1980) for example in relation to transport-related disadvantage. Ashmore, Farrington and Skerratt (2017) look at community-led broadband in rural digital infrastructure to assess its impact on the resilience of rural communities. They find that community-led broadband featuring a "localism" development approach can strengthen local rural individual identity and rural resilience, but it may also entrench existing inequalities and feelings of exclusion. Wallace, Vincent, Luguzan, Townsend and Beel (2017) investigate how ICT influences social integration in rural communities. They conclude that ICT is an integral part of rural social relations but can play very different roles for different social and cultural groups as well as for communities in different locations. Ashmore, Farrington and Skerratt (2015) look at the relationship between rural dwellers and high speed broadband, highlight that the relationship is complex and can be contradictory at times, and that more research needs to be done.

MAAS AND TECHNOLOGICAL OPTIMISM

Despite what is known about the inequalities in technology diffusion and adoption, technology optimism, and even determinism, is dominant in the promotion of MaaS. Positive rhetoric which praises the perceived benefits of MaaS is widespread and a number of umbrella bodies have been created to bring together stakeholders, particularly commercial stakeholders, whether working at the centre or on the fringes of the concept. Several large claims have been made for the potential benefits of MaaS, such as *reduced road congestion, improved air quality, healthier travel choices, increased efficiency in transport networks and more effective management of transport demand. (*House of Commons, 2018 p. 3), but it is also recognized (beyond the walled gardens of the promotional alliances) that uncontrolled deployment of MaaS could have negative consequences (Pangbourne et al., 2018).

Examining MaaS through a rural lens

Firstly and significantly, much of this rhetoric is spatially blind. Few of the claims made for MaaS focus on addressing rural problems. For example, the alliance organization, MaaS Catalonia, has developed a MaaS Manifesto containing a set of principles that should guide how MaaS should be deployed in Catalonia. This does not include any reference to addressing geographical inequalities, though one might interpret the principles as implicitly covering non-urban settings (*MaaS should foster social inclusion and promote socially responsible behaviour. Social inclusion and inequality concerns need to be a fundamental part of the service for it to be socially sustainable. For governments, MaaS is the opportunity to address a wide range of policy goals from environmental sustainability, to smart mobility and integration.* Principle 2, MaaS Manifesto, MaaS Catalonia). Given that the Generalitat de Catalunya was a project partner in MyWay (EU FP7 Grant number 609023) and MyWay was required to cover the whole of Catalonia, not just the metropolitan area of Barcelona, it would suggest that governance actors intend that rural areas should be served equitably through MaaS initiatives, but this is not always made sufficiently explicit.

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The MaaS documents from promoters and stakeholders that were collected for this study have been surveyed for the attention they pay to deploying MaaS in a rural setting. The results are shown in Table 2, and with only a very few exceptions, the focus is clearly 'urban by default', with hardly any material specifically focused on requirements for rural MaaS. MaaS Scotland stands out, if only because their document contains a lot of summaries of pilots and projects under development in rural areas, which perhaps reflects the Scottish Government's commitment to the economic and social interests of its substantial rural areas, something that subsequently is reflected in a recent funding call for innovation projects (Transport Scotland, 2019) (at the time of writing the successful projects had not been announced). These sources are listed in date order, but there is no apparent trend to increase or decrease focus on rurality.

Table 2 Mentions of 'rural' in non-academic MaaS-related documents, in date order from 2015-2018

Title	**Source and date**	**No. of pages**	**Mentions of rural**	**Comments**
Mobility as a Service Can it be even better than owning a car?	Sampo Heitanen and Sami Sahala, slide set, no date	56	0	
Exploring the opportunity for Mobility as a Service in the UK	Transport Systems Catapult, July 2016	52	1	
Mobility as a Service: the next transport disruption	LEK Consulting sponsored by UITP & TTF Australia, no date but not before 2016	14	0	
Mobility as a Service The End of Car Ownership?	Sampo Heitenan, CEO, MaaS Global, slide set, no date but not before 2016	43	0	
The rise of mobility as a service	The Deloitte Review, issue 20, 2017	20	0	
Reimagine Places: Mobility as a Service	KPMG, August 2017	32	3	Developed an illustrative scenario for a rural setting

MaaS Roundtable	Foresight Future of Mobility Project, Government Office for Science (UK)	4	0	
Guidelines and recommendations to create the foundations for a thriving MaaS ecosystem	MaaS Alliance White Paper, September 2017	22	1	
EPOMM Project e-update	EPOMM Project, December 2017	4	0	
Moving Together	MaaS Alliance, leaflet, no date	2	0	
Mobility as a Service: Positioning Scotland for an Emerging Global Market	MaaS Scotland, January 2018	24	19	Rural is mentioned in a number of pilot project summaries.
Mobility-as-a-Service The value proposition for the public and our urban systems	ARUP, March 2018	52	4	On the basis of little evidence, the conclusion comments “Current evidence suggests that service provision in rural and low density suburban locations is a strong proposition” p. 41
Mobility as a Service Putting Transit Front and Center of the Conversation	Cubic, March 2018	24	1	
Data makes MaaS happen - MaaS Alliance Vision Paper on Data	MaaS Alliance, November 2018	9	0	

Exploring Mobility-as-a-Service: insights from literature and focus group meetings	Netherlands Institute for Transport Policy Analysis (KiM) for Ministry of Infrastructure and Water Management, November 2018	28	12	Most mentions indicate the geographic location of participant quotes rather than a substantive treatment of requirements or opportunities for rural MaaS. The conclusions are not promising for rural MaaS: "In order for MaaS to be successful, the service must, at any rate, offer autonomy and flexibility, be reliable, and ideally be available anytime and anywhere. Presumably, the latter is not a realistic point of departure in rural areas." p. 26
Mobility as a Service	Intelligent Transport In-Depth Focus, volume 2, issue 3, no date	13	0	
Mobility-as-a-Service and changes in travel preferences and travel behaviour: a literature review	KiM Netherlands Institute for Transport Policy Analysis for Ministry of Infrastructure and Water Management, September 2018	57	2,	The mentions are in the context of a review of DRT in rural areas, with MaaS covered as an URBAN concept
A Business Case for Mobility as a Service	SkedGo, Business brochure, 2018	7	0	
Problem Statement: Mobility as a service business models	New South Wales Government, 2018	4	1	

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Requirements for developing rural MaaS

It remains the case that most MaaS proposals, pilots and deployments have been initiated in highly urbanized settings. In order to understand what is necessary to apply MaaS to rural transport issues, we can look at the problem through the first seven core characteristics of MaaS identified by Jittrapirom et al., (2017). The author does not consider personalization and customization further here.

Integration of transport modes: this characteristic presupposes that there is a choice of existing modes that should be integrated, to enable users to undertake multimodal trips more easily. Jittrapirom's model does extend beyond urban settings by encompassing long-distance services (bus/coach or train) as well as flights and ferries, but this overlooks the daily mobility practices of rural residents, which may be intra-rural or between rural and urban environments. There is therefore a need to understand the trip-making needs of rural residents and comparing that to the available transport modes before attempting design a rural MaaS.

Tariff option: a key characteristic of new MaaS models is that they offer users a tariff choice between a) paying a monthly subscription which buys access to a range of transport options with caps on use based on distance or time or numbers of trips or b) paying per use (Pay-as-you-Go, PAYG). Typically, the PAYG option is more expensive per trip than a bundled package, requiring the user to guestimate which option will provide them with better value. Caps based on distance or time are likely to work out very expensive in rural areas. Therefore, there is a need to design fair pricing models for rural areas.

One platform: This characteristic of MaaS is based on users having a single point of access (though it could have several interfaces, e.g. web-site or mobile app) for accessing mobility, potentially alongside other services, such as weather forecasts, synchronization with personal calendars, a trip record and other feedback. A potential issue for rural areas is that rural dwellers may fall between different MaaS providers' regions or need to travel alternately between the areas covered by different MaaS providers if these radiate outwards from urban centres, and this aspect of interoperability needs to be considered from the perspective of people outside urban settings.

Multiple actors: the digital MaaS platform is multi-sided, providing benefits for multiple actors in the transport ecosystem, both on the demand and supply side, as well the platform owners. Cooperation is also needed by additional non-transport actors – handling payments, providing data management services, telecoms services, other information services (e.g. weather forecasts). On the face of it, this aspect does not have peculiarly rural facets, except that there may be fewer other information services and telecoms services may depend on availability of infrastructure. In terms of achieving economies of scale to support public transport, in the past rural areas often relied on hybrid passenger/small logistics services such as Post Buses. ICT provides opportunities to recreate this approach for 21st century rural areas: this potential needs more in-depth evaluation and scoping (and could be linked to the tariff characteristic above).

Use of technologies: a key aspect of technology that underpins MaaS is the presence of a reliable mobile internet network. This is an area of weakness in many rural areas, that needs to be overcome if rural MaaS is to provide the quality of service to mobility users and suppliers alike.

Suitable ICT infrastructure is a foundational determinant that precedes any consideration of user adoption and acceptability.

Demand orientation: the MaaS paradigm is described as user-centric, in its offer of 'the best' option(s) for the individual user, with demand-responsive modes being available. In a rural setting, there are generally far fewer alternative modes available from which to select a 'best' option, and the economies of scale for providing more mobility are likely to be reliant on concurrent sharing of rides, whereas sharing in urban settings can be more reliant on sharing vehicles sequentially. There is a public ambivalence about sharing that needs to be overcome (Marsden, Anable, Bray, Seagriff & Spurling, 2019); this is an aspect where rural areas might have an advantage of urban areas, as there is more of a culture of informal ride-sharing (Gray, Shaw & Farrington, 2006).

Registration requirement: the requirement to register with the MaaS platform is fundamental to the personalization elements (and data generation) that are central to the value proposition for MaaS. This can be as an individual, or via a group (such as a business or a household). Whilst the MaaS product might utilize public transport modes (such as bus, tram, metro or train), it is not itself public transport. The requirement to register is a barrier to use as it requires the adoption of one technology to use another, and it also requires users to have certain other privileges such as a bank account. Adoption of some of the technologies around this is affected by both rural infrastructure issues and acceptance. For example, there may also be acceptance issues relating to registration with older demographics found in rural areas.

SOLUTIONS AND RECOMMENDATION

Rural mobility has been a topic of research for a many years, but transformation in rural connectivity is as patchy as ICT for many. In the UK as elsewhere, 'austerity' policies have resulted in dramatic contractions to the bus network. Considering this, there has been renewed interest in finding solutions. The problems of rural areas that are exacerbated by the characteristics of rural communications networks (both transport and ICT) are well recognized, as discussed above. It is also the case that MaaS solutions have been developed almost exclusively for urban settings, where the issues are congestion and air pollution, with social and distributional issues in accessibility. Consequently, the rhetoric of MaaS proponents is focused on addressing urban problems, omitting the opportunities offered by addressing rural needs, as is demonstrated in the analysis of the documents that promote and discuss MaaS (see Table 2).

Whilst MaaS is now being reconceptualized for rural environments, see for example the rural MaaS principles developed by Eckhardt et al., 2018, but also the guidance issued by Transport Scotland in relation to its MaaS Innovation Fund (Transport Scotland, 2019b), this chapter has sought to demonstrate how the problems that need to be addressed are different to those in urban areas. This is step is important for authorities to be able to take appropriate action. Accessibility and inclusion issues arise from poor connectivity and consequent functional car dependence is linked to high greenhouse gas emissions from rural transport – there are generally no public transport options beyond buses and providing bus public transport in rural areas is very expensive.

Pangbourne, K. (2020) Challenge, Coordination, and Collaboration for Effective Rural Mobility Solutions. Chapter 4 in *Implications of Mobility as a Service (MaaS) in Urban and Rural Environments*. Eds: Amaral, A. M., Luís Barreto, L., Baltazar, S., Silva J. P., and Gonçalves, L. IGI Global, ISBN13: 9781799816140

As most rural residents have increasingly provided for their own mobility by acquiring access to private cars, the existence of any kind of bus network becomes less and less viable. There has been awareness of this issue for many years. The EU-funded FAMS (Flexible Agency for collective demand-responsive Mobility Services) project achieved proof-of-concept for a technology that would support the provision of rural demand responsive public transport in 2004 (CORDIS, no date). The FAMS project ran successful trials in Tuscany (Italy) and Angus (Scotland, UK). This was clearly an early example of what we now refer to as MaaS. In relation to taking an existing DRT model and digitizing it, thereby bringing DRT closer to Intelligent Transport Systems (ITS), the FAMS project made some important advances. However, this model has yet to be widely adopted, with regulatory and institutional barriers identified by the project still existing.

There are also specific and unique opportunities in rural areas: one transport issue in many rural areas is the long distances for parcel delivery (which in the case of some parts of the UK results in extra charges for customers), there are institutional barriers to overcome to integrate between logistics and passenger transport. Whilst many levers for the provision of passenger transport and delivery of transport policy lie at local level for example, this is not the case for logistics. There needs to be space made for testing innovative ideas, which creates a collaboration requirement.

The Scottish Government (Scotland is a constituent nation of the UK with its own devolved administration) has recognized that smart mobility poses an innovation issue for Scotland – whilst more than half the population live in the urbanized central belt, considerably more than half the land area is remote rural, and poorly connected to the railway network. Scotland is a highly car dependent nation outside the main urban centres. The Scottish Government is investing £2m over three years to stimulate near-market innovation in MaaS (the MaaS Scotland Investment Fund) (Transport Scotland, 2019a). There is an expectation that the proposals will contribute to practical testing of the viability of MaaS in Scotland in a manner that also addresses the strategic agenda of the Scottish Government. The aims are specified as being modal shift to sustainable public transport alternatives, reducing carbon emissions; healthier lifestyles, by incorporating active travel modes (traditional modes of transport such as bus or rail are considered active as they have an element of walking involved to access, as well as more regular active options such as bike schemes); but also supporting digital innovation within Scotland, specifically relating to public transport. In year 1 proposals must fit with one or more of three themes – rural, islands and communities; tourism; and Tackling Inequality, Accessibility & Mobility barriers (Transport Scotland, 2019b).

However, it remains to be seen whether proposals will be fit for rural areas, as the limitations of the fund restrict heavily the ability to undertake research, and thus are looking for pilot projects that already have a Minimum Viable Product, with a need for minimal development, existing evidence for a market, a commercial strategy for a sustainable business model and to have already undertaken co-creation or stakeholder engagement. There is also a technical requirement that pilot projects should be compatible with the existing smart mobility information infrastructures (cEMV, mobile and ITSO). This could strongly limit any community MaaS proposal and will hamper new ideas from outside the traditional transport sector. Notwithstanding that MaaS is not really a new concept, the fundamental features of what we now

call MaaS has potential to provide some solutions to existing problems in transport provision is clearly recognized by policy-makers, transport authorities and academics.

However, there is a risk that the digitizing and 'subscriptionizing' of access to mobility through a single point might have dangers in relation to exclusion, particularly for those wishing to travel in rural areas – part of this relates to the existence of less well off or older individuals without bank accounts, or from a strong tendency not to use mobile technology at all, or at least not to use it for payment. However, a structural issue relates to the ICT connectivity and mobility infrastructure constraints of rural areas. Demand responsive transport, bookable by telephone, has long been an answer to providing socially necessary transport solutions in rural areas, and these have also been digitized (as with the FAMS discussed above), but as most DRT solutions are community transport services, often run by charity groups, this existing solution has not yet been systematically incorporated into a rural MaaS solution. However, if this is to make use of the benefits of mobile ICT, the rural connectivity issue must be addressed, which requires collaboration and coalition building between the *community* transport sector (to provide a use for the ICT infrastructure), government (to provide incentives) and telecommunications (to build the infrastructure).

Serving a collective good is a core ethos of community transport providers, and thus these actors may not naturally find common ground with commercial MaaS brokers. Focusing on individual preferences in MaaS product design (such a self-centred focus is clear in the MaaS Australia articulation of the concept, see Table 1) draws us away from the collective good. However, clarity is needed around how exactly MaaS can avoid exacerbating known future issues and this means that influencers and decision-makers need to ask three questions:

1) What are the local transport problems, and would MaaS address these?
2) Does the MaaS proposition reduce or worsen local social problems where unequal accessibility/mobility is a contributory factor?
3) Can MaaS genuinely make users' transport choices more environmentally sustainable by reducing GHG and other negative impacts in the specific context under consideration?

The answer to question one has been so far seen as most significant for urban areas which are beset by significant air quality problems and congestion. However, in this environment, the transport ecosystem is such that MaaS providers can be both regulated and incentivized to encourage their users to be less reliant on the car-based options in the multi-modal mix. i.e. the bulk of trips made by MaaS users need to be by public transport (bus, light and heavy rail) and to involve much more walking and cycling (potentially also e-scooters where these are legal).

There are some obvious limits to active travel's suitability in rural areas, where trip distances are typically much longer and lacking in safe infrastructure for walkers and cyclists. Furthermore, as highlighted in the foregoing sections, the contraction of rural public transport has proceeded in a vicious cycle with rising private car use over many decades. Thus, the issues that MaaS propositions should focus on in rural areas are those relating to social inclusion and greenhouse gas emissions reduction.

However, in rural areas cross-benefits might be achieved through co-distribution where freight vehicles are used by more than one company to improve loadings and reduce overall vehicle mileage, or combining some logistics activities with passenger mobility, as with the example of the Swiss Postbus (which used to exist in the UK for example, at least until the 1980s in some places). Such a move would strongly synergise with another widespread trend: the increase in internet-facilitated home-shopping and associated rises in light goods vehicle-based deliveries. Better coordination of this kind of traffic, including co-distribution (reference) and the potential to combine with passenger movements, offers GHG emissions reductions for rural areas which are otherwise 'hard to treat'.

MaaS can also be designed to address question two. This is particularly pertinent to rural areas, and the community transport DRT services are a case in point. Rural traditions of informal lift-giving within families and communities might also be leveraged through a true 'sharing economy' facilitated with MaaS-style mobile apps that reward sharers in some way. However, the public nature of rural transport services might be undermined. For example, can we really call transport public if citizens must register before they can use it?

In relation to question three, there is a need to measure the true impacts of solutions devised to address questions one and two, especially as the sharing of vehicles and services is seen as particularly crucial to making transport more sustainable in rural areas, and such sharing is intuitively seen as more environmentally sustainable. If it can be shown that a rural MaaS can address the transport issues, and that the social needs of rural residents can be equitably supported by the product at the same time, can it also be shown that there is a net reduction in environmental impacts?

It appears to the author that one thing that has not been found in MaaS to date, even in urban settings, is the inclusion of vehicle fueling (though there are fuel card account systems used in the logistics industry or by businesses). For rural areas, where functional car dependence is almost certain to remain for some considerable time, the need to address climate change by switching to low carbon vehicles could be supported by including fueling for any fuel type or vehicle-to-grid contracts in rural MaaS business models. How this might work is that customers could book time on an EV point at a Park and Ride system (or wherever they need to go, be it their workplace, shopping centre, place of education, or healthcare provider) via the MaaS, and that the energy required by their vehicle is either PAYG or an allowance included in their monthly package; if their vehicle is supplying energy to the grid the user is paid instead. Some elements of this approach would be resilient to different forms of low-carbon vehicle, should EVs not be the sole or longer-term solution.

However, there is also a fourth question that is relevant to many rural areas:

4) How might rural MaaS enable or constrain the mobility of day visitors and tourists to rural areas?

Given the economic significance of rural tourism, and its high environmental impact, it is important to direct tourists to services with lower impacts. Registration can be a barrier to that, and it is hard to imagine that rural residents will be willing to offer peer-to-peer sharing with

non-resident strangers in sufficiently large numbers to have a meaningful environmental impact. Furthermore, given the substantial dependence of most rural populations on travel in private cars, there are some significant issues in developing a multi-modal MaaS provision that will be adopted by the rural population, is it possible for a rural MaaS to provide a comprehensive transport service without a substantial reduction in individual flexibility? Adopting a social enterprise model for a rural MaaS may be one appropriate way forward capable of addressing the four posed questions, and there could be technological solutions to support the establishment of interpersonal trust in privacy protective ways using agent-based software models.

FUTURE RESEARCH DIRECTIONS

In considering how rural MaaS needs to be designed to address specific spatial and social context of rural areas, it is helpful to understand that whilst it needs to contribute to solving a range of problems, it is unlikely to be the sole solution. This is a helpful perspective from which to consider how rural MaaS needs to be developed, and the four guiding questions above provide a framework for systematically interrogating the degree to which a rural MaaS proposition addresses those questions.

More attention needs to be paid to the range of perspectives on feasibility and adoption that exist amongst rural stakeholders and potential end-users. In relation to feasibility this relates strongly to what would constitute a suitable business model for rural MaaS. A true 'sharing' model may sit better with the traditional ideas of rural reciprocity and mutual support, suggesting that social enterprise models, and user-centric design, should be a priority for focused investigation.

Furthermore, there needs to be more research into how rural MaaS platforms can enable peer-to-peer sharing alongside both community and commercial provision (perhaps through a social enterprise model), how co-distribution and shared small logistics/passenger transport can be revived and stimulated and also how the continued need for personal-car based transport can be brought into the ecosystem beyond lift-sharing, to stimulate the uptake of low-carbon vehicles.

CONCLUSION

This chapter has built on the argument that MaaS is not guaranteed to live up to the overly optimistic rhetoric that is employed by its proponents. Evidence is provided that the rhetoric is spatially blind in its neglect of the different socio-spatial conditions affecting rural transport versus urban transport. The reasons for this are presented, but it is a significant issue for rural areas, which have a unique set of trends, in relation to an ageing demographic, contracting population, and poor ICT and public transport service levels. In theory MaaS has a lot to offer in solving some of the social and environmental consequences of this, but more needs to be known about how to build reduced and zero-carbon rural transport options in to rural MaaS, a challenge that should not be underestimated. New collaborations could be achieved in rural areas that would create more viable MaaS offering, if better coordination can be achieved between currently separate areas of provision, such as health and social transport, as well as micro-logistics.

Secondly, rural areas perhaps need a more communitarian MaaS offer, to reflect the socio-cultural differences of rural areas and to reduce the need to make a profit where population density reduces the commercial opportunity. A more 'modern' image for a social MaaS rural

transport service offer might also support the maintenance of population levels, that would help stem the outward migration and balance the age profile of rural areas which would further support the maintenance of sustainable rural livelihoods and ecosystem services.

A key conclusion is that addressing spatially specific issues needs to be made more prominent in the discourse around MaaS, with a recommendation that effort is made to include meaningful discussion on the potential for rural MaaS to be designed and operated for the collective good. This effort can and should draw on the wealth of knowledge about social need for mobility in rural areas, and on the abundant work exploring more flexible options that has been done over the years before MaaS took the spotlight. As the profitability of a commercial approach to rural MaaS is clearly in question, a social enterprise model should be a serious consideration.

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