

# COULD MOBILITY AS A SERVICE (MaaS) HAVE A ROLE IN AN INTEGRATED PUBLIC TRANSPORT NETWORK IN SOUTH AFRICAN CITIES?

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## ABSTRACT

Mobility-as-a-Service otherwise known as MaaS (Hietanen, 2014) can be regarded as a shift away from personally-owned modes of transport towards mobility solutions that are consumed as a service. It involves combining transport services from public and private transport providers through a unified gateway that creates and manages trips. This paper looks at what capabilities are required for MaaS to be introduced, whether these capabilities exist in South Africa and what further could or should be done if MaaS is to enable integrated public transport networks in South African cities.

The paper identifies the following as critical components for the introduction of MaaS:

- A wide range of transport modes;
- Enabling and supportive government legislation in the financial and transport sectors;
- Majority of transport operators who share their operational data with third parties and allow third party service providers to bundle and sell transport services to the consumer;
- Consumers who are willing and able to consume MaaS services as well as stakeholders who are not opposed to Maas Services.

It concludes that with a supportive financial and transport regulatory environment, open data and open payment systems, MaaS can happen and contribute to integrating public transport in South African cities.

## 1. INTRODUCTION

There is a mobility revolution that is sweeping across many parts of the developed world, most often referred to as “Mobility as a Service” (MaaS) (Hietanen, 2014). MaaS can be regarded as a shift away from personally-owned modes of transport towards mobility solutions that are consumed as a service. It involves combining transport services from public and private transport providers through a unified gateway that creates and manages trips (Holmberg, Collado, Sarasini, & Williander, 2016)

This paper looks at the international experience of MaaS and will evaluate whether or not MaaS is on the horizon in South African cities and the conditions necessary for it to play a role in integrating public transport and thus improving public transport as a mode of choice in South African cities.

## 2. LITERATURE REVIEW

Mobility as a Service (MaaS) can be considered of as an idea (a new way for generating mobility), a phenomenon (occurring with the rise of new behaviours and technologies) and as a new transport solution (which combines the diverse transport modes and mobility services) (Flood, 2015).

One of the most comprehensive definitions of MaaS was offered by Hietanen (2014) who described MaaS as a mobility distribution model that meets users' transport needs through a single interface. It integrates diverse transport modes to offer a tailored mobility package, not dissimilar to a mobile phone contract. Some of the core attributes of MaaS according to Hietanen are customer's need-based, service bundling, cooperation and interconnection between transport modes and service providers.

Cox (2015) adds to this definition by emphasizing the comparability with the telecommunication sector. Following on from this, Finger, Bert & Kooper (2015) envisioned MaaS to integrate transport modes through the internet.

Holmberg, Collado, Sarasini, & Williander (2016) expanded on the role of subscription in delivering MaaS, giving commuters the possibility to plan his or her journey in terms of booking and paying for the several transport modes that might be needed all in one service. MaaS is thus a new approach to collaboration and integration of transportation providers where a user engages on a single platform to coordinate and facilitate their mobility needs (Matyas & Kamargianni, 2017).

The European Commission (European Commission, 2015) notes that a paradigm shift in transport is expected through MaaS, where service providers offer easy, flexible, reliable, cost-effective and environmentally sustainable daily travel to commuters, which includes services like, public transport, car sharing, car leasing and road use, as well as more efficient shipping and delivery options.

Typically to access MaaS, commuters are asked to register for an account. At a first level this is to make booking and payment easier, as the idea envisions a 'seamless' combination of all transportation modes and then at a further level, a 'Mobility Aggregator' gathers and sells all services through a single smartphone application, allowing easy fare payment and one-stop billing (Dotter, 2016).

Based on their needs, travellers can choose to 'pay-as-you-go' or to pre or even post pay, taking into account their registration and a monthly subscription. A subscription based service can lead to personalisation or collaborative customisation by designing mobility services around traveller's preferences, which is missing from conventional public transport services (Atasoy, Ikeda, Song, & Ben-Akiva, 2015).

In some ways MaaS builds on existing technology advancements where mass transit users are able to have their first or last mile needs, met by combining 'park and ride' facilities that enable people to park their cars or bikes and continue their journey with public transport. Similarly, travel information for different modes of transport including public transport has become increasingly digitized and available on smartphones for real-time planning and routing information (Kramers, Ringenson, Arnfalk, & Sopjani, 2018)

Thus, MaaS can be seen as a mobility service that is flexible, personalized and on-demand and has the potential to contribute to integrating public transport. It has a strong

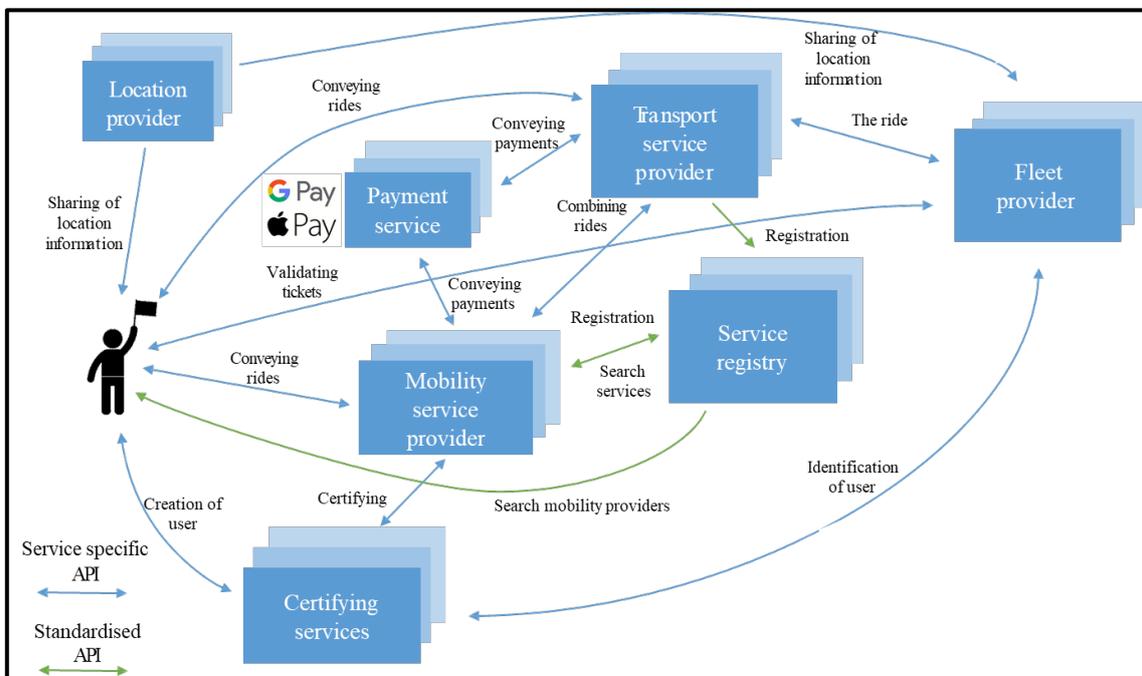
user-centric vision and has been seen, not only as contributing to more effective mobility for customers but also crucial for improving air quality and reducing carbon emissions.

### 3. MaaS REFERENCE ARCHITECTURE

To be able to evaluate whether MaaS can be introduced in South African cities to integrate public transport, it is useful to identify what are the critical elements that enable MaaS. This is referred to as the MaaS reference architecture.

A MaaS reference architecture was developed using information collated via the literature review. Each requirement was reviewed and linked to one of the following four ‘capability’ domains:

- The consumer or passenger who will gain value from using MaaS;
- Business or public transport service providers who can provide MaaS services or invest as further spelt out in Figure 1 below;
- Technology and data requirements needed to support MaaS; and
- Government policy and regulation that would enable MaaS.



**Figure 1: Building Open Mobility as Service Architecture Adapted from Scalable Mobility Markets – Building Open MaaS Ecosystem**

Further, Figure 1, above identifies the following roles for the service providers:

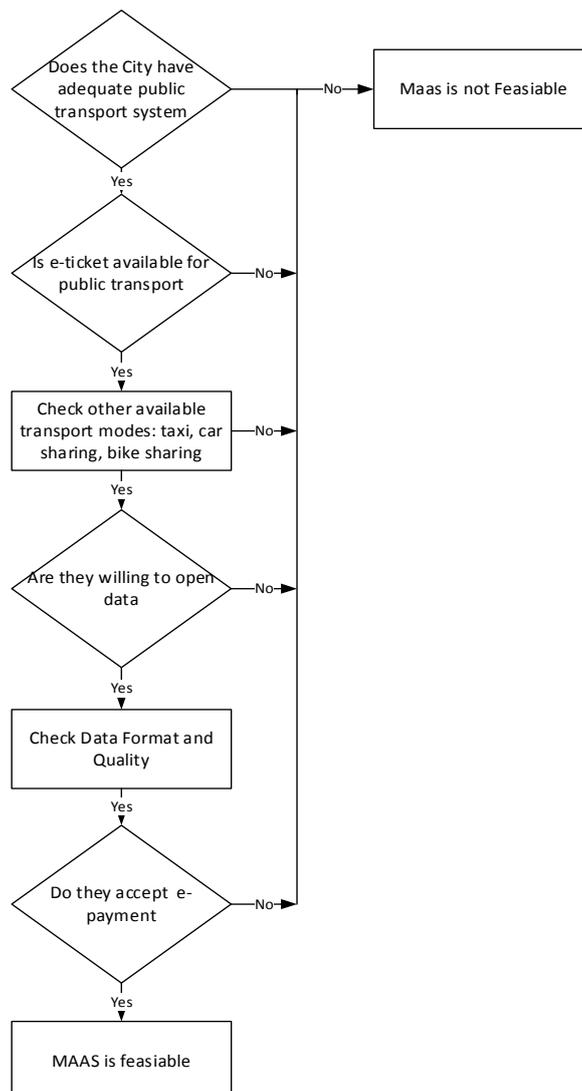
- Mobility service provider whose role it is provide mobility and supporting services ( as broker of mobility services or supplier of aggregation technologies to the commuter and or transport service provider);
- Payment service provider whose role it is to broker payments between the user and the mobility service provider;
- Location provider whose role it is to collect and offers location information of users and vehicles;
- Fleet provider of other mobility solutions like bike or car sharing, carpooling and vehicle rental;
- Identification service provider who identifies and confirms the identity of a customer or another service provider;

- Service registry to which service providers can register their service and search for other services; and
- Transport Service provider: The role of a transport service provider is to provide transport services to the commuter.

#### 4. CONDITIONS TO MAKE MaaS A REALITY IN SOUTH AFRICAN CITIES FOR INTEGRATING PUBLIC TRANSPORT

This paper argues that to develop and operate MaaS in South Africa, the following conditions need to be met:

- A wide range of transport modes – both mass transit such as rail or BRT and last mile modes such as e-hailing and short-term car rentals are available;
- Government policy legislation at least do not contain obstacles and at best create an enabling environment for MaaS;
- Majority of transport operators are prepared and able to open their data to third parties including real-time data;
- Majority of transport operators allow third parties to sell their services;
- Majority of transport operators offer e-ticket or e-payment access to their services;
- There are consumers who are willing and able to consume MaaS services as well as stakeholders who are not opposed to MaaS Services.



**Figure 2: Check list of operating Mobility as a Service in South Africa taken from: MaaS Challenges of Implementation and Policy**

Figure 2 above is a checklist to analyse whether MaaS can be introduced in South African cities and the subsequent sections discuss how far South African cities have come, what are the obstacles and opportunities to embrace MaaS.

This is discussed further below.

#### 4.1 A wide range of transport options

Few transport services in South Africa have been digitalised to enable commuters to plan and pay for journeys end to end on one platform. In most South African cities there is a fairly wide range of service providers including mini bus taxis, rail, buses including BRT buses, e-hailing – Uber or Bolt (Taxify). Other last mile options such as short term car hire and bike sharing are present in a few niche areas.

While attempts by local authorities have been made in recent years in major metropolitan cities such as Cape Town, Tshwane, Johannesburg, eThekweni to plan for integration, transport services remain fragmented. Although projects such as the Gautrain high-speed rail service and a few bus rapid transit routes have been introduced, these are not integrated in a logical manner. The traditional commuter rail, bus and 16-seat taxi industries therefore operate in policy silos and, in the case of the bus and rail industries, are planned and funded independently of each other, leading to a further lack of integration. MaaS has the potential to overcome this in some instances e.g. Allowing a commuter to use rail and e-hailing as part of one trip.

However, for South Africa to create a mobility ecosystem as described above, all transport operators need to be willing to share their scheduling and pricing data in non-proprietary data format and allow the installation of sensors on their fleet that will allow users of transport services to see the total transport supply that is available at any given time. MaaS can generate value for transport operators in several ways. Transport operators can use MaaS to reach a wider market and increase their market share. Furthermore, a MaaS eco-system would provide improved information to operators about real time transport demand and supply. This would be particularly useful in peak hours when some of the transport operators run at full capacity where a MaaS system can re-route their demand to other transport operators and avoid passenger dissatisfaction.

By dynamically managing supply and demand transport providers can increase their revenue by reaching previously 'unreachable' commuter segments and change the negative perception around public transport. The MaaS provider can create competition between engaged transport operators leading to improved levels of mobility services.

Lastly MaaS can also create more business opportunities, not just in Uber or Taxify but in supporting the public transport value chain and enabling a shift from private car use to mass transit.

#### 4.2 Government policy and legislation

Currently there is no national policy or legislation enabling MaaS. At the time of writing this paper, Parliament and the National Department of Transport are working to pass legislation which will create an enabling regulatory environment for e-hailing which could be regarded as a precursor to enabling MaaS.

MaaS would require that the South African government ensure that all transport service providers adhere to common standards, provide public transport data in open data formats and ensure payment systems that are smartphone based that can be supported by government.

Government can play an enabling role by ensuring a more supportive financial and transport policy frameworks for the sustainable development of the transport market. This could enable fair competition, open up different sources of financing (peer to peer loans), passenger rights, privacy, security, service quality standards, social inclusion, and safety.

The policy framework for MaaS must be developed at a national level in order to ensure any government supported programs use the same open standards across different provinces or cities this will ensure and interoperable architecture that ensures the same user experience for ticketing and scheduling systems. This standard will embrace international standards that will enable international visitors to the country to use public transport ubiquitously.

The international experience is that the successful implementation of MaaS relies on government being a co-operative and supportive partner. As Ross Douglas writes in a 7 June 2018 edition of *Autonomy* about MaaS: “These developments are changing the game for cities. In the past they had to think about transport provision for citizens, a capital intensive and complex business. Now all they need do is pass good policy and issue licenses accordingly to resolve transport problems. City authorities will become referees, inviting multiple private companies to compete for licenses to operate on their road and street infrastructure – and possibly above it too.”

One of the critical challenges is to find the appropriate level of regulations, where the public interest is balanced against what is required for the private sector to take part and innovate in MAAS. According to (Lund, Kerttu, & Koglin, 2017), the aim of regulation should be in “ensuring transparent market conditions and fair market performance and securing the legal position of consumers and travellers”.

An important issue relates to the subsidisation of tickets for public transport which has implications for how public transport operators are allowed to sell their ticket as well as the boundaries between state subsidized mobility services and commercially viable services, and how these can be combined in MaaS solutions. This is complicated because modes and not passengers are subsidised in South Africa.

If MaaS means that many different forms of mobility services are combined, the boundaries between public transport and privately offered services such as e-hailing, carpooling etc. become blurred and this may mean the abovementioned privately offered services should also be subsidised.

The extent to which the development of MaaS is perceived to be a threat to the current models for taxation and financing of infrastructure, as well as models for collecting revenue from existing transport services which may constitute a barrier for supporting this innovation. Notwithstanding that new transport services are likely to present new opportunities for revenue and tax income, perhaps based on data from connected travellers' actual infrastructure use and time of use ( McKerracher, Orlandi, Ramku, & Hannon, 2016) Current personal income tax legislation creates perverse incentivising the purchasing of cars instead of promoting the use and or participation in MaaS schemes.

### 4.3 Service registry

Integrating various forms of open data through APIs (application programme interface) is a prerequisite for the development of an integrated mobility service. The ability to capture data with mobile devices and sensors regarding services, infrastructure, and MaaS users' needs is critical, as is the need to ensure that data is stored and retrieved quickly, reliably, and securely.

South Africa lacks the skills and digital literacy, to adapt to the unparalleled levels of variability in scale, speed and data required for MaaS. However an open collaborative approach between government and industry to improve the skills base, and incubate SMME's who write applications for public transport could build the skills base needed to develop different types of applications that could support MaaS.

Cloud computing concepts, such as non-relational database technology, will need to be used to facilitate agile and real-time data management requirements. To ensure that the latest encryption tools and protocols are applied and followed, scalable data warehouses and large distributed file systems must be regulated by rigorous security and data policy conditions.

Currently most trip planning API's (applications programme interfaces), only have capabilities for journey planning, fare estimation a real time scheduling information. However, in a MaaS eco-system, API's for purchasing transit tickets will have to be incorporated into one application. MaaS can enable access to new markets for data brokerage services which can create opportunities for additional revenues and market growth for all participants in the Maas ecosystem.

The sharing of scheduling data from some rail, BRT and bus systems in South Africa with Google, is an example of progress towards adopting an open and interoperable data standard for sharing public transportation data in South Africa. While cities and service providers have often struggled to market and package their information from various real time public transport information systems, many cities have opted to create an open API, to share their data with the public and have decided partner with GTFS transit programme, instead of developing their own public transport application.

Google and Bing Maps has become a de facto standard in how to display and digitise real time scheduling data. Google map and navigation services allows transport service providers to reach a much wider audience based on the dominant position that Google enjoys worldwide. The second reason is that Google Transit APIs, General Transit Feed Specification (GTFS) and GTFS Real Time, are easy to understand and simple to use. If South African cities want MaaS, the goal should be to learn from Google Transit, and develop user - friendly APIs that make it easy for individual operators like the taxi industry to join MaaS.

### 4.4 Open Payment Systems

Open Payments is the use of contactless bank cards such as MasterCard PayPass, VISA Wave and AmericanExpressPay to pay transit fares. Open payment systems coupled with open data systems can simplify the integration of service providers from both a customer perspective and back-end processes. It can also provide versatility in selecting the most suitable device vendor or vendors for each operator. An open, flexible system can also

assist operators from other industries such as parking, tolling and other retail channels without having to reconfigure existing equipment.

Public transport operators can considerably reduce the need for them to manage aspects of fare collection if this responsibility is passed on to financial institutions or replaced with a mobile application. The shift to "pay as you go" or pre-payment using self-service channels also reduces the need for agencies to use expensive retail sales and sales machines.

With interoperable systems, new applications can be seamlessly integrated and the system upgraded to remain compliant with financial regulations. However, those who currently operate custom-built systems may need to completely rebuild or make costly modifications to existing systems and install new devices to pursue open payment.

By leveraging smartphones and other mobile devices, passengers could discover, query, select and pay fares in a way they are familiar with and thus grow public transport usage. The increase in smartphone usage in South Africa creates an important opportunity to allow multiple payment forms, including smart media and mobile ticketing via smartphones. Busy commuters will benefit from the ease of use of their smartphones to pay for their travel tariffs.

Therefore, in order for MaaS to become a reality in South Africa, it is necessary not only to embrace open data standards for sharing scheduling information, but also to include new open payment standards such as Apple or Google Pay, and to have a suitable regulatory framework for this.

#### 4.5 MAAS service providers and institutional co-ordination

Institutional coordination is needed to integrate information, ticketing, scheduling and physical planning to create a seamless travel experience for passengers of the magnitude envisaged by MaaS. An institutional form needs to be backed by a set of standards that all participants need to agree to.

The majority of MaaS business models have a broad range of key partners and customers as well as revenue streams in common as well as extensive development and provision of interoperable and integrated services bearing in mind that some actors attract more customers than others.

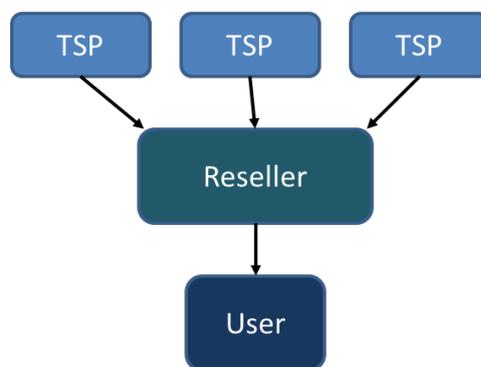
Government can support the development of new, integrated mobility services through enabling MaaS pilots if it could fund or guarantee funds for these. One of the few trials that were conducted in Gothenburg Sweden as part of the Ubigo Pilot, could not continue due, to the lack of financial support. Although the pilot was successful, and a company was formed, neither of the stakeholders involved, nor governmental financial bodies were able to support further development, primarily because of institutional barriers.

Depending on who takes the role of the MaaS service provider or integrator, implications vary. As public transport is mostly seen as the backbone of MaaS it could be perceived as a natural step that an existing public transport operator or a regional transport agency would take this role. But it could also be better if, an external and independent actor who has no previous commitments maybe be freer to arrange new service combinations as they seem fit.

If a public transport operator takes the role as coordinator of the integrated mobility service, the service would most likely be designed to maximise use of the existing public transport system, rather than maximising customers' service satisfaction. However, public transport is generally seen as a backbone for successful MaaS systems and experience shows that ride- and car-sharing works best in areas where public transport is strong. Similarly, Uber and taxi have the highest pick-up rates in areas where public transport is a good option as well (UITP 2016).

Further on the one hand, it might be easier to attract new customers to a new integrated mobility service if the service is less connected with existing mobility providers but rather branded as a new, intelligent mobility service. On the other, a large number of various services without linkages may emerge and there is a risk that the individual traveller perceives the system as being too complicated.

The authors believe based on the discussion above that in the South African context, a business model where there is a third party MaaS operator is most appropriate. In this model set out in Figure 3 multiple services from various transport service providers (TSPs) are combined and offered to end users via one interface.



**Figure 3: Commercial MaaS operator models Adapted from Mobility as a Service Business and Operator Models**

The abovementioned model fits in well with MAAS architecture framework described in Figure 2 where ticketing and scheduling data can be built using open Application Programming Interfaces (API) for easy integration of third parties. This open architecture approach helps to reduce the task of connecting passengers with retail outlets to purchase their fare media and can incorporate the other transport service providers.

#### 4.6 Attractors and detractors

The MaaS model enhances value to customers by offering them uncomplicated, affordable and tailored mobility. MaaS is by its nature a user-centric model and customer focused model. In South Africa where the average household spends 20 to 25% of their income on mobility there is a large potential market to exploit for actors that are able to attract customers through new, innovative transport solutions. Another driver for both public and private investors and operators in the MaaS market is the fact that many of today's journeys involve travellers experiencing some type of frustration, such as time and monetary costs of commuting in South Africa.

If the uptake of e-hailing services and Gautrain is anything to go by, a market for MaaS does exist amongst predominantly upwardly mobile young professionals and other middle

class strata living in cities. Maas could be implemented in South Africa in such a way that it would link to public transport subsidised services, in this way it could also serve lower middle class and working class strata, even if only for occasional trips such as to health care and recreation.

However, there are also potential detractors particularly those who are not able or do not want to provide their data and thus could lose market share. The most prominent detractor is the taxi industry. To address this associations can be incentivised to participate in MaaS scheme with those who do not, potentially losing out of the benefit from the addition demand generated by Maas.

## **5. CONCLUSION**

The MaaS concept is strongly based on digitalization and is a new way of thinking for the transportation sector, it may take time for commuters and public transportation operators to accept it at first. It will however be important for Maas operators to understand the benefits and the requirements for both commuters and operators so that suitable solutions and payment methods can be developed. This will require a sophisticated communication and marketing campaign to enable and support a behavioural change.

Can MaaS be introduced in South African cities? The short answer is yes, but it requires transport operators to overcome certain obstacles related to open data and the use of ICT in the payment of transport services. In addition, government must provide a supportive and enabling regulatory environment in both the finance and transport policies. If this is done Maas has the potential to extend beyond the middle and professional classes and bring more private sector financing and business expertise to the South African public transport industry

## **6. REFERENCES**

Atasoy, B, Ikeda, T, Song, X & Ben-Akiva, M, 2015. The concept and impact analysis of a flexible mobility on demand system. Washington DC: Transport Research Board.

Bright, C, 2018, September 21. Mobility: South Africans have to find local solutions to solve congestion problems. Retrieved from Mail & Guardian: <https://mg.co.za/article/2018-09-21-00-mobility-south-africans-have-to-find-local-solutions-to-solve-congestion-problems>

Cox NCJ, 2015. Estimating demand for new modes of transportation using a context-aware stated preference survey. Massachusetts Institute of Technology.

Dotter, F, 2016, August 2016. Mobility-as-a-Service: A new transport model. Retrieved from CIVITAS: <https://civitas.eu/content/civitas-insight-18-mobility-service-new-transport-model>.

Douglas, R, 2018, June 7, MaaS. Retrieved from Autonomy & the Urban Mobility Summit: <https://www.autonomy.paris/en/ourteam/ross-douglas/>.

Eckhardt, J, Aapaoja, A & Sochor, J, 2017. Mobility as a Service business and operator models. 12th ITS European Congress. Strasbourg: ResearchGate.

European Commission, 2015, October 14. Smart, green and integrated transport - Work Programme 2016–2017. Retrieved from Horizon 2020:  
<https://ec.europa.eu/programmes/horizon2020/en/smart-green-and-integrated-transport-%E2%80%93-work-programme-2016-2017>.

Finger, M, Bert, N & Kupfer, D, 2015, January 05. Third European Intermodal Transport Regulation Summary as-a-Service: from the Helsinki experiment to a European Model? Retrieved from Technical report, European Transport Regulation Observer:  
<http://fsr.eui.eu/Documents/WorkshopPaper/Transport/2015/150309MaaSObserver.pdf>

Flood, A, 2015. Journey of the Future Introducing Mobility as a service. Retrieved from Atkins Global:  
[https://www.atkinsglobal.com/~media/Files/A/Atkins-Corporate/uk-and-europe/uk-thought-leadership/reports/Journeys%20of%20the%20future\\_300315.pdf](https://www.atkinsglobal.com/~media/Files/A/Atkins-Corporate/uk-and-europe/uk-thought-leadership/reports/Journeys%20of%20the%20future_300315.pdf)

Hietanen, S, 2014. Mobility as a Service-The new Transport Model. Eurotransport, pp.2-4.

Holmberg, EP, Collado, M, Sarasini, S & Williander, M. 2016. Mobility as a Service-MaaS. Describing the framework (Final report MaaS framework). Transport Research Board, 54.

Kramers, A, Ringenson, T, Arnfalk, P & Sopjani, L, 2018. Indicators for Promising Accessibility and Mobility Services. Sustainability.

Lund, E, Kerttu, J & Koglin, T, 2017. Drivers and Barriers for Integrated Mobility Services. K2 Working Papers.

Matyas, M & Kamargianni, M, 2017. The Business Ecosystem of Mobility-as-a-Service. Transportation Research Board (pp. 8-12). Washington DC: Transportation Research Board.

McKerracher, C, Orlandi, I, Ramku, S & Hannon, E, 2016, October. An integrated perspective on the future of mobility. McKinsey & Company.

Mobility as a Service Exploring the Opportunity for Mobility as a Service in the UK, 2016, July. Catapult Transport Systems.

Yanying, L & Tom, V, 2017. Mobility as a Service (MaaS): Challenges of Implementation and Policy Required. International Transport Forum (pp. 95-106). Paris: Scientific Research.