Chapter 9
MaaS as a Catalyst for the Public Transport Revolution in Developing Countries

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Abstract The Mobility-as-a-Service phenomenon entails the integration of different public and private transport, considering public transport as a backbone. The applicability of MaaS schemes is closely related to efficient public transport networks, which is not a reality in several developing countries. In this chapter, we present a new perspective on MaaS. Thus, we believe that for a revolution in public transport, MaaS can be a catalyst. We consider MaaS as a business model that can be modular and adaptable to any reality. By considering public transport as the backbone (whether it is efficient or not) its eventual inefficiency can be balanced with the integration of private actors, corroborating with the context of smart cities, and new alternatives for private transport means (e.g., autonomous vehicles and shuttles). To this end, we consider precepts from business ecosystem, PSS, eco-innovation, consumer behavior – and the act of sharing. Approaches like these can guide the applicability of MaaS in the context of Smart Cities and new perspectives, such as Corporate MaaS and Rural MaaS.

Keywords MaaS · Public transport · Ecosystem

9.1 Introduction

Since the beginning of humanity, mobility has been a concern for human beings. Currently, we have Autonomous Vehicles (AVs), but the search for better forms of mobility started as soon as the first man was as far as his legs could reach.

We certainly do not want to compare the current urban complexity of a megalopolis like São Paulo, Paris, or New York to the simplicity of getting around on foot

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in primate times but rather to illustrate how the essence of mobility can be applied to these two examples similarly.

When a Parisian wakes up in the morning and walks to a subway station to catch the RER[1] and get to his job, the goals in terms of mobility are similar to that of Homo Erectus who moved in search of food more than 500,000 years ago; leave point A to reach point B. Although much has evolved since then, the essence of mobility remains, and all the other consequences of this are ways to achieve this goal in a more efficient, systemic, sustainable, and/or comfortable way. With the evolution of private automobiles, for example, we stopped using the horse as the primary form of transport and started to rely on internal combustion engine machines[2] that could help us in our mobility in a much more comfortable, efficient way, and, as everything indicated at the time, more sustainable.[3] In July 2019, a conference on urban mobility was held in Helsinki with the aim of discussing different perspectives on public transport and our cities. At that time, the urban designer Mikael Colville-Andersen commented that, in the early 1920s, the streets used to be an extension of our homes' backyards. Before the widespread adoption of private cars, we had space to walk, talk, and spend time with friends on the streets with greater freedom and security. Facts that are no longer a reality.

Nevertheless, then, what has changed? The answer: we lost the fight against cars.

Of course, this is an extremist answer ... In general, the fact is that this happens because the design of our cities brings a favorable perspective in all aspects to automobiles, and makes it difficult for the circulation of pedestrians or other modes of transport.

Have you stopped for a moment to think that approximately 2/3 of the urban space, considering sidewalks and streets, are destined for cars? – In many cases, this ration can be even greater.

However, in the Finnish capital, this is not a reality. Over there, what happens is just the opposite. The streets were narrow, and the sidewalks were wide. Cars share their space with trams. Public transport operates at an impressive pace with very reasonable waiting times, and in excellent conditions. Bike paths and shared bicycle stations are scattered throughout the city, offering access to a significant portion of the population. The result of that? Life without a car there is a feasible possibility.

With all this effort for more fluid urban mobility, it is no coincidence that the concept of Mobility as a Service (MaaS) was born in Finland in 2014. MaaS is a distribution model of mobility that delivers users' transport needs via a single service provider's interface by combining different transport modes to offer a tailored mobility package – just as a monthly mobile phone contract (Hietanen, 2014).

[1] For those who have never had the privilege of living or going to Paris, RER is one of the main train lines that run through the French capital.

[2] Some people say that humanity will never trust autonomous vehicles (...) discussions for other times.

[3] One of the great promises of automobiles shortly before its vertiginous rise in 1910 was the ideal replacement of waste left by horses (shit). The fact is cars would then no longer "pollute" cities—one of the great mistakes of our modern civilization.

From its early days in 2014, MaaS has acted as a disruptive catalyst against the "obligation" of owning a car (e.g., Whim app[4]). Most literature discussions relate to the balance between public and private transport, offering commute alternatives that are most convenient at the moment (Jittrapirom et al., 2017; Kamargianni, Li, Matyas, & Schäfer, 2016).

Several authors state that public transport entails the backbone of MaaS systems (Karlsson, Sochor, & Strömberg, 2016; Pangbourne, Stead, Mladenović, & Milakis, 2018; Sochor, Arby, Karlsson, & Sarasini, 2017), which undoubtedly contribute to the spread of MaaS schemes.

How Will MaaS perform in places where public transport is not efficient? That was the first question we asked ourselves when using Whim in Helsinki.

Nevertheless, before trying to answer this question, it is essential to highlight the correlation between the need for car ownership vs. the inefficiency of public transport in some underdeveloped countries, such as Brazil.

In Brazil, the "success" of a car is correlated to public transports' inefficiency. Delays, unavailability, little coverage, poor infrastructure, among other aspects, can be mentioned here (see more in Chap. 8). Also, safety is another factor that must be taken into account. Unlike other countries on the north axis, in Brazil, it is not very safe to use public transport late at night, for example. In addition, for many Brazilians, the car is much more than an instrument of mobility and assumes a symbolic role of desire and status. The compilation of instrumental, symbolic, and affective factors (Steg, 2005) and the theory of practice approach (Reckwitz, 2002; Warde, 2005) contributes to this. However, we argue that that the car acts mainly as "mobility insurance" (Flügge, 2017). He's there, as an "ambassador" for individual freedom, available in your garage to take you anywhere, anytime.

Thus, owning a car means that the value proposal delivered by any other means of public transport, in many cases, is not sufficiently superior to leaving a private vehicle in the garage. According to Sprei (2018), the private-owned vehicle is still holding its dominant position, and shared mobility *per se* might not be attractive enough to disrupt the transportation system.

Although well studied, like any other new approach, MaaS concepts are still incipient in the literature (Ambrosino, Nelson, Boero, & Pettinelli, 2016; Matyas & Kamargianni, 2018; Strömberg, Rexfelt, Karlsson, & Sochor, 2016). Thereby, it is worth highlighting that all current studied MaaS systems take place in developed countries (Jittrapirom et al., 2017; Kamargianni et al., 2016), and the advances in MaaS are being constructed especially in Europe (Hensher, 2017).

In this way, bringing studies about its evolution from places where public transport is mostly efficient can come loaded with biases when incorporated without filters to other realities, as is Brazil's case. Back to our concern made in Helsinki; "Would it be possible to implement MaaS models in places where public transport is inefficient and add value to the user?"

[4] Whim is the MaaS operator available in Helsinki. It works as an app on the smartphone, in which it is possible to choose the transport modes better fit it to the use.

To try to answer this question, we bring an analysis under a new conceptual MaaS perspective proposed by Gandia, Antonialli, Sugano, and Nicolaï (2019), built from the precepts from business ecosystem (Moore, 1993), Product-Service System (Tukker, 2004), eco-innovation (Rennings, 2000), and consumer behavior (Belk, 2010).

Based on this approach, it is possible to build value for MaaS, sufficiently superior to private vehicles' exclusive use. Thus, MaaS initiatives, implemented in an orchestrated way in specific locations, can act as catalysts for public transport use.

9.2 MaaS as a Disruptive Innovation and AVs as a Disruptive Technology

We understand that MaaS and AVs present distinctions in terms of disruption. The former can be considered a disruptive innovation by creating new markets without the need to deliver a breakthrough technology. According to Flügge (2017), all the solutions for MaaS are here, and we need to orchestrate them. For the latter, we understand it as a disruptive technology for the utterly advanced technology of AVs regarding the traditional automotive industry.

The MaaS 'potential to create new markets (Mulley, 2017) is closer to the new market disruption concepts proposed by Christensen and Raynor (2003). Corroborating with this, Sprei (2018) states that to be genuinely disruptive shared mobility has to have the potential to grow beyond niches, and one way to improve this attractiveness is combining different services, such as MaaS. However, the technological disruption of AVs does not necessarily deliver the creation of new markets. For instance, if autonomous taxis replace the driver, they will be like other taxis. Complementary, we cannot rely on those technological innovations alone, leading to a desirable disruption from society's point of view (Sprei, 2018).

In this sense, MaaS and AVs will not be, *per se*, the disruptive solution for urban mobility. We believe that they should be analyzed in a complementary way to achieve a disruption in mobility.

9.3 Smart Cities and the Ecosystem of Mobility

With rapid global advances and organizational complexity, significant changes occur in the business environment, especially concerning technology, physical environment, market forces, consumer behavior, and finance (Chesbrough, 2011).

The concept of smart cities proposes that the evolution of digital technologies increasingly connects with traditional structures combined with ICTs (Batty et al., 2012). The interconnected complexity of smart cities is increasingly part of the ecosystems of our urban centers. In this sense, the notion of ecosystems has gained

attention in academic literature as a concept to understand and explain the complexity of the interconnected nature of the modern business environment (Durst & Poutanen, 2013; Lehto, Hermes, Ahokangas, & Myllykoski, 2013).

Since the seminal work of business ecosystem (Moore, 1993), several authors agree that the definition and concept of an ecosystem are unclear, and there is still much work to be done to establish it (Daidj, 2011; Iivari, Ahokangas, Komi, Tihinen, & Valtanen, 2016; Koenig, 2012; Peltoniemi & Vuori, 2004; Tsujimoto, Kajikawa, Tomita, & Matsumoto, 2017).

In this way, many different definitions of the business ecosystem emerge. Iivari et al. (2016) affirm that a business ecosystem refers to a network of organizations involved in developing and delivering a specific product/service through competition and cooperation. However, for Peltoniemi and Vuori (2004), there is no need for government interventions to a business ecosystem survivor because they are self-sustaining.

In a MaaS context, many authors contributed to the Business Ecosystem enforcement (Gandia, Antonialli, et al., 2019;Jittrapirom et al., 2017 ; Kamargianni & Matyas, 2017). MaaS ecosystem is built on interactions between different groups of actors through a digital platform, under different layers: demanders of mobility (i.e., private customer or business customer), a supplier of transport services (i.e., public or private), and platform owners (i.e., third party, public transport provider, public authorities).

Other actors can also cooperate to enable the service's functioning and improve its efficiency: local authorities, payment clearing, telecommunication, and data management companies (Jittrapirom et al., 2017; Kamargianni & Matyas, 2017).

From a new perspective, in an initial effort, Gandia, Antonialli, et al. (2019) analyzed MaaS under the ecosystem approach, based on the precepts of eco-innovation and the Product-Service System (PSS).

A PSS concept can be defined as an integrated bundle of products and services that aims to create customer utility and generate value (Boehm & Thomas, 2013). Similarly, Annarelli, Battistella, and Nonino (2016) state that a PSS is a business model focused on providing a marketable set of products and services designed to be economically, socially, and environmentally sustainable, with the final aim of fulfilling customer's needs. According to Centenera and Hasan (2014), a PSS is an integrated combination of products and services for optimal consumption. Besides the multiple definitions, we observed that a PSS aims to create value for users by setting in joint offer products and services.

This approach proposes that, far beyond delivering value when it comes to mobility, MaaS models are part of an ecosystem that must be understood, from the value delivered to the user to the sustainability of the proposed mobility models. This model is present in the next section.

9.4 Unveiling MaaS: The Theoretical Tripod of Business Ecosystem, PSS and Eco-innovation

One of the significant criticisms about MaaS is the lack of theoretical support. In this sense, Gandia, Antonialli, et al. (2019) tried to bridge this and support MaaS from the perspective of three main concepts: Business Ecosystem, Product-Service System, and Eco-Innovation.

In general, the Business Ecosystem theory's assumption states that MaaS has several agents (competitors or not) that must be combined and act collaboratively. For this, assigning MaaS as a result-oriented PSS is essential, because only then can multiple solutions be combined to offer the best-expected result. From a customer perspective, an integrated solution allows for 'one-stop-shopping' and enhanced efficiency and effectiveness (Kuijken, Gemser, & Wijnberg, 2017).

However, if all this effort is not enough to contribute to a favorable sustainability scenario, the model should not be applied. Gandia, Antonialli, et al. (2019) argue that a successful MaaS system is one that not only integrates transport modals but one that considers the eco-innovation concept by attracting to its platform both public transport users and car owners.

Eco-innovation can be conceived as a conventional innovation when they are concerned with the environment and sustainability (Aloise & Macke, 2017; Rennings, 2000). Mainly for MaaS we consider eco-innovation to reduce car ownership or more efficiently use it by user and "not-sharing" peer-to-peer commuters.

When analyzing MaaS in developing countries (with their public transport inefficiencies), it is unlikely that the platform would attract most private vehicle users (as in scenarios, such as Helsinki or Stockholm). On its current configuration, with no adaptations to the local reality (such as the Brazilian context), MaaS is doomed to failure. Thus, to minimize any rebound effects (Manzini & Vezzoli, 2003), a new MaaS perspective was proposed, MaaS 2.0 (Gandia, Antonialli, et al., 2019).

9.5 A New Perspective: MaaS 2.0

What reason would you have to set aside the car, the "ambassador of freedom", to use any other transport model? That question supports the discussions towards proposing this new perspective of MaaS, in version 2.0 (Gandia, Antonialli, et al., 2019). Such a proposal does not aim at eliminating private vehicles. Its forerunner, Sampo Hietanen, makes it quite clear that MaaS model is not for everyone and is not its intention to replace vehicle ownership (Hietanen, 2019).

However, according to Gandia, Antonialli, et al. (2019), MaaS 2.0 proposes that, for the model to be well applied, it is necessary that a substantial number of private vehicle owners shift to the MaaS model, even in places where public transport is not as efficient.

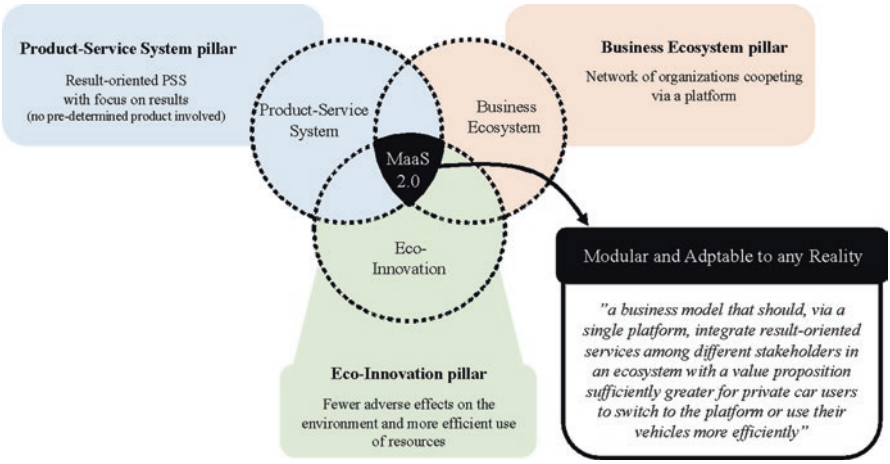

Fig. 9.1 MaaS 2.0 under the theoretical tripod of PSS, Business Ecosystem, and Eco-Innovation. (Source: Adapted from Gandia, Antonialli, et al., 2019).

Furthermore, we believe that to "win the fight" against "car need seekers",[5] more than integrating public and private transport is necessary. To enable this shift, MaaS must first be treated as a business model, where contextual factors must be analyzed, and the value generation for each user segment becomes a premise. Thus, Gandia, Antonialli, et al. (2019) propose that MaaS 2.0 should integrate not only transport modes but also several actors of an ecosystem to deliver value to the user. In this way, the theoretical tripod of PSS, Ecosystem, and Eco-innovation can be met (Fig. 9.1).

Thus, the main difference between the current MaaS and MaaS 2.0 is that the MaaS evolution seeks to share and integrate transport modes and other stakeholders (not directly related to mobility). By this, other industries, such as entertainment, retailers, food service, and even housing, can be a part of MaaS 2.0. At this level, the need to own a car could be drastically reduced, while the ecosystem complexity would increase (Gandia, Antonialli, et al., 2019).

This model's premise is that the greater the user's value, the greater the chance that he will not use a private vehicle. However, to deliver more value, a more significant number of stakeholders in this ecosystem is needed to generate network effects (Gandia, Antonialli, et al., 2019), which makes it more complex, following the precepts of Tukker (2004) and result-oriented PSS.

As shown in Fig. 9.1, MaaS 2.0 is considered "a business model that should, via a single platform, integrate result-oriented services among different stakeholders in an ecosystem with a value proposition sufficiently greater for private car users to switch to the platform or use their vehicles more efficiently" (Gandia, Antonialli, et al., 2019, p13.).

[5] We tried here to bring a term to the "excessive desire to use vehicles", I do not know if I was successful, but that was the idea of this word.

With that, MaaS can be considered as a modular business model that can be adaptable to several realities. Under this view, the dynamics that permeate MaaS 2.0 are correlated with Smart Cities functionalities' precepts when related to smart mobility typology, which must meet the sustainable, innovative, and safe transport system (Batty et al., 2012).

9.6 Low- or High-Tech Transport Modals Which Would Better Fit MaaS?

When dealing with MaaS, especially from a smart cities' perspective, the need to bring precepts in which cutting-edge technology is needed comes to the forefront. The fact is the ICTs and the two-sided market platform technologies required for the MaaS to function (Giesecke, Surakka, & Hakonen, 2016; Ho, Hensher, Mulley, & Wong, 2018; Jittrapirom et al., 2017; Kamargianni et al., 2016; Matyas & Kamargianni, 2018; Utriainen & Pöllänen, 2018) the technological capacity of the transport modes that are part of their ecosystem must be treated differently.

This means that there are low-tech alternatives within the modal-split to implement a MaaS business model. For instance, sharing a car may be used as a transport modal in a MaaS system, and casual carpooling may be an alternative to implement MaaS in the context where this transport mode is accepted (Gandia et al., 2019). Therefore, the choice of transport modes must be oriented by the MaaS ecosystemic business model based on these users' result-oriented value proposition.

Regarding Autonomous Vehicles, it is undeniable that this technology will affect the future modal-split of urban mobility. To achieve AVs' dissemination, technical aspects are already waiting for the evolution of non-technical knowledge fields, such as ethics, laws, public policies, and deep studies on consumer behavior (Gandia et al., 2018).

However, although AVs' technological development can be considered globally, local specificities should be taken into account, considering social, economic, legal, and governmental particularities as determinant factors (Gandia et al., 2020). More details on AVs are found in chapters; 3 – legislation aspects of AVs, 4 – public policies for AVs, and 10 – governance models for urban mobility innovations).

Thus, the answer to the question "low- or high-tech transport modals, which would better fit MaaS?" is dependent on the context in which the MaaS business model will be employed. Furthermore, for MaaS, the value proposal must be aligned with proposition variables to obtain the best response to local users' pains and needs.

9.7 Conclusion

The discussions in this chapter suggest several propositions that sustain MaaS to act as a catalyst for the public transport revolution in developing countries.

First, it is worth highlighting that mobility solutions' technical development is not the solution for urban mobility. Similarly, the phenomenon of Mobility as a Service should be better analyzed by other perspectives. In order to take place in the future of urban mobility, MaaS must be considered as a modular and adaptable business model, applicable to several contexts (the efficiency – or inefficiency – of public transportation should not be a limiting factor). For this, the business model of MaaS should be established under the ecosystemic approach – and sustainability should not be considered as an intrinsic feature in a MaaS business model.

As a business model, MaaS can be modular and adaptable. As previously seen, its applicability can be derived from the incorporation of low-tech practices (such as casual carpooling in small towns) to the technological disruption presented by autonomous vehicles and shuttles. The fact is that it is precisely this modularity of MaaS that makes it independent from high-tech transport modes, allowing us to consider it as a disruptive innovation.

This innovative ecosystem business model must take into account consumer acceptance and the transport modes that fit the specific context established (either for developed or developing economies). In other words, a successfully implemented MaaS system in Sweden will likely not have the same success rates in Brazil, whether or not "tropicalized".[6]

We are certainly not saying that disruptive technologies such as autonomous vehicles are irrelevant or obsolete for the Brazilian context (see more in Chap. 8). However, we consider that AVs' implementation will complement, in specific contexts, the demands of users in a MaaS' ecosystem. The deployment of AVs can also occur outside a MaaS business model ecosystem, in specific places and contexts.

In this sense, AVs should be considered one among several elements in the future urban mobility ecosystem. One example to be considered is the optimization of routes based on AVs' use and sharing (Mourad, Puchinger, & Chu, 2019), which may or may not be present in a MaaS model. However, we believe that this is a reality in the medium and long term, in more developed countries, without many perspectives in underdeveloped countries, precisely in which public transport is most needy and inefficient (see more in Chap. 8).

Second, another essential point to be reinforced is related to the balance between public and private transport coming from the practices of MaaS. Whether in countries where public transport is efficient or not, the fact is that Brazilian urban mobility is strangled by private vehicles, and the integration solution is the one that promotes better prospects to relieve this channel.

Thus, MaaS, as a business model, can offer solutions that deliver value to the user in a creative, low-cost manner, not necessarily relying on cutting-edge technologies. As examples, it is possible to mention, free rides as a strategy to implement MaaS in small towns (Gandia, Oliveira, et al., 2019), the MaaS used by companies, CMaaS (Hesselgren, Sjöman, & Pernestål, 2020), and the use of MaaS

[6] Tropicalization means adapting the characteristics of a product or service to the realities of the local context. The term tropicalize serves mainly tropical countries, such as Brazil.

in rural regions (Barreto, Amaral, & Baltazar, 2018; Eckhardt, Nykänen, Aapaoja, & Niemi, 2018).

Indications like these bring MaaS adaptability and modularity perspectives to be applied in a context where AVs are a reality, even regions where casual carpooling is a possibility.

Aspects like these make MaaS, employed as a business model, in its 2.0 vision, to act as a catalyst for the public transport revolution, regardless of the composition of the ecosystem's transport modes (low- or high-tech), it is possible to deliver value to users and contribute to the balance between the use of public and private transport.

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