The potential of Mobility as a Service to Deliver Sustainable Value and Implications for Business Models

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Abstract

Mobility is one of the greatest environmental challenges we face today. Therefore, there is increasing pressure to transition to a more sustainable urban mobility system, giving rise to Mobility-as-a-Service as a potential solution to reverse private car ownership. It consists of a digital interface that integrates existing transport modes and offers users the possibility to plan, book, and pay for upcoming trips. However, the complexity of this concept imposes several questions regarding its potential to deliver what it promises to. Therefore, the objective of this thesis is to understand the potential of this service to deliver sustainable value and the implication this has on its business models. The approach applied was qualitative exploratory research by conducting semi-structured interviews with industry experts. The findings reveal that the sustainability of Mobility-as-a-Service depends on (1) its ability to capture the segment of private car users to be profitable in the long run, (2) the extension of the public transport network with other forms of collective mobility to achieve social inclusion, and (3) the innovation of existing business models from vehicle suppliers and manufacturers to integrate environmentally sustainable objectives. Achieving these three goals requires stakeholders to engage in a reciprocal and mutually beneficial relationship. This research contributes to a holistic understanding of the ecosystem business model by considering the needs of key stakeholders.

Keywords: Mobility-as-a-Service, MaaS, Sustainable business models, Business ecosystem, Stakeholders, value proposition, value creation, value capture

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Abstrato

A mobilidade é um dos maiores desafios ambientais que enfrentamos hoje em dia. Por conseguinte, existe uma pressão crescente para a transição para um sistema de mobilidade urbana mais sustentável, dando origem à Mobilidade-como-um-Serviço como uma potencial solução para inverter o uso do carro particular. Consiste numa interface digital que integra os modos de transporte existentes e oferece aos utilizadores a possibilidade de planear, reservar e pagar viagens. No entanto, a complexidade deste conceito impõe várias questões quanto ao seu potencial para entregar aquilo que promete. Portanto, o objetivo desta tese é compreender o potencial deste serviço para criar valor sustentável e a implicação que isto tem no seu modelo de negócio, através da realização de entrevistas semi-estruturadas a *experts* da indústria. Os resultados revelam que a sustentabilidade da Mobilidade-como-um-Serviço depende (1) da sua capacidade de captar o segmento de utilizadores de carro particular de forma a ser rentável a longo prazo, (2) da extensão da rede de transportes públicos com outras formas de mobilidade coletiva para alcançar a inclusão social, e (3) da inovação dos modelos de negócio existentes dos fornecedores e fabricantes de veículos para integrar objetivos ambientalmente sustentáveis. A realização destes três objetivos exige que as partes interessadas se empenhem numa relação recíproca e mutuamente benéfica. Esta investigação contribui para uma compreensão holística do modelo empresarial do ecossistema, ao considerar as necessidades dos principais interessados.

Palavras-chave: Mobilidade-como-um-serviço, Modelos de negócio sustentáveis, MaaS, Ecossistema empresarial, Intervenientes, proposta de valor, criação de valor, captura de valor

Título: O potencial da Mobilidade-como-um-Serviço criar valor sustentável e a implicação que isso tem nos modelos de negócio

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List of Abbreviations

API	Application Programming Interface
BM	Business Model
BMI	Business Model Innovation
e.g	for example,
etc.	and so forth
GHGs	Greenhouse gases
G-D	Good-dominant
i.e.,	that is,
MaaS	Mobility-as-a-Service
n.d.	no date
PPP	Public-Private-Partnership
PT	Public Transport
PTA	Public Transport Authority
S-D	Service-dominant
SDGs	Greenhouse gases
SDGs	Sustainable development goal(s)
SBMI	Sustainable Business Model Innovation
vs.	Versus

1. Introduction

The increasing population and urbanization trends have contributed to a growth of private car ownership in urban areas which has brought several negative consequences to society, namely congestion, increased CO2 emissions and bad air quality (Adriazola-Steil, 2013). At the same time, the automotive industry is in a midst of huge disruption characterized by the emergence of several trends namely shared mobility (Gao et al., 2016), which together with the proliferation of information technology (IT) such as smartphones enabled the emergence of alternative modes of transport namely car-sharing and micro-mobility (Sonuparlak, 2012). However, the overabundance of modes has fragmented the mobility ecosystem (Lang et al., 2020) giving rise to Mobility-as-a-service as a potential solution to solve these problems (OECD, n.d.). The complexity of this concept imposes several questions regarding its potential to deliver what it promises to (Jittrapirom et al., 2017). Therefore, this paper aims to answer the following question, which is divided into the four pillars:

- How can the MaaS business ecosystem create, deliver, and capture sustainable value?

MaaS promises to move more people in a faster, clean, and less expensive way compared to current options (Goodall et al., 2017). Due to the novelty of the concept, there is not yet a formal definition (Jittrapirom et al., 2017), however, it can be described as the integration of the existing transport modes into one mobile app accessible on-demand (Whim, 2016). From a business perspective, it can be defined as a digital ecosystem of integrated mobility partners who deliver new services to the end customers and combine various services into high-value offerings through a platform (MaaS Alliance, 2017). Therefore, its business model integrates many different actors and thus, its ability to deliver sustainable value is also dependent on them.

So far, the literature that crosses both MaaS and business models has mostly focused on the separate elements of the business model such as revenue sources, operating models, potential mechanisms for value capture, and possible organizational schemes (Molinares & García-Palomares, 2020). Others have presented business model prototypes through the deployment of the business model canvas (Polydoropoulou et al., 2020). Lastly, there is one paper that addresses the characteristics of MaaS sustainable business models (Sarasini et

al., 2017), however, it does not provide a holistic perspective that considers the objectives of all actors involved and the respective roles.

To fill this gap, this thesis aims at understanding the potential for MaaS to deliver sustainable value and the implication that this has on its business models by not focusing solely on the platform operator's perspective. The approach used was a qualitative exploratory design by conducting semi-structured interviews with industry experts. This study contributes to a better understanding of the business ecosystem by making clear the role of each actor and how their collaboration creates shared value. Therefore, we aim to give practical implications on how to create a win-win situation in which all the actors who contribute to the value creation can capture part of that value.

This thesis consists of five parts: Chapter 2 starts with an overview of the sustainability concept by stating the root cause and how to drive towards a sustainable economic system. Then, it addresses sustainable urban mobility, followed by a description of the MaaS concept, the potential benefits of its implementation, and its business ecosystem. Lastly, it introduces the sustainable business model concept. Chapter 3 describes the research approach used and the data collection process. Chapter 4 organizes findings according to the research question. Chapter 5 discusses key findings. Chapter 6 states the main conclusions and recommendations. Finally, Chapter 7 states the limitations.

2. Literature Review

According to the United Nations Brundtland Commission, sustainability is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." (UN, n.d.). Currently, climate change imposes a big threat on the ability of the planet to support modern civilization, calling out for radical changes in societies, especially at a business level.

2.1. Sustainability

The following chapter addresses the current challenge humanity is facing, followed by the principles of a sustainable society, and lastly, the role of business in driving society towards a more resilient system.

2.1.1. Current situation

During the past ten thousand years, the planet earth has been through a geological period named the Holocene, marked by stable sea levels, stable temperatures, and predictable seasons which enabled civilization (Clay, 2021). However, in 2002, the concept "Anthropocene" was introduced in the International Geosphere-Biosphere Programme (IGBP) newsletter, as the name given for a new geological epoch created by human activity. Nowadays, this concept is widely used by the scientific community (IGBP, 2010) who has recently declared that humanity is now on the Anthropocene epoch. (Carrington, 2016).

Evidence shows that since 1880, the average global temperature on Earth has increased by a little more than 1° Celsius (2° Fahrenheit) (NASA, n.d.). The increased concentration of CO2 in the atmosphere has accelerated the rate of melting of the glaciers to a point where the Greenland ice sheet is disappearing four times faster than in 2003 and already contributes 20% of the current sea level (Hancock, n.d.). The glaciers are a precondition for the planet to stay in the stable Holocene era (Clay, 2021). Therefore, if society continues to emit greenhouse gases (GHG), it will get to a point where the planet will not be capable of sustaining humans and wildlife anymore.

2.1.2. Towards a sustainable society

Fortunately, the understanding of how the planet works is always advancing, and in 1989, a group of scientists discovered four root causes that undermine the human capacity to survive and thrive on the planet. These causes were translated into four robust systems conditions that define sustainability at a principle level (The Natural Step, 2018).

"In a sustainable society, nature is not subject to systematically increasing …

1. … concentrations of substances from the earth's crust (eg. fossil CO2)
2. … concentrations of substances produced by society (eg. antibiotics)
3. … degradation by physical means (eg. deforestation),

and, in that society …

4. … human needs are met worldwide"

The first three conditions are related to human interaction with the planet, whereas the last one is related to achieving social sustainability because if basic needs go unmet, humans will continue to harm the environment in their effort to survive (The Natural Step, 2018). These principles were created from the presumption that matter must be processed in cycles, therefore society should use resources efficiently and fairly, substitute toxic or rare substances by nature's abundant materials, and develop new technologies (Srinivas, n.d.). This provides guidance for any individual or organization interested in moving towards sustainability. (Srinivas, n.d.)

2.1.3. Business role in Sustainable development

Whilst sustainability is often thought of as the long-term goal, sustainable development refers to the many pathways to achieve sustainability in four intertwined dimensions - society, environment, culture, and economy (UNESCO, n.d.). The sustainable development goals (SDGs) are thus the blueprint to achieve a more sustainable future by addressing the global challenges humanity currently faces (UN, n.d.).

Most key priorities from the SDG framework are linked with business activities - companies emit GHGs, consume energy and natural resources, require water and transport, use toxic materials, and produce waste - Conversely, environmental damage is increasingly affecting businesses too, from the scarcity of essential resources to the economic costs of environmental pollution (Larderel, 2009). In essence, business is as much part of the problem as part of the solution.

Therefore, driving towards a sustainable economy requires a fundamental shift in almost every aspect of how a business is run (Bocken et al., 2014). The features of a sustainable economic system might be: (1) a system that encourages minimizing consumption, (2) maximizes societal and environmental benefits rather than prioritizing economic growth, (4) emphasizes delivery of functionality and experience, rather than product ownership, (5) is built on collaboration and sharing (6) is designed to provide fulfilling, rewarding work experiences for all, and (6) a

closed-loop system where nothing is allowed to be wasted or discarded into the environment (Bocken et al., 2014).

The vital role of business becomes even more evident with the Paris Agreement, in which the European Union (EU) aims to have an economy with net-zero GHG emissions by 2050 (European Commission, n.d.). Urban areas play a significant part in reaching this objective as they account for more than 70% of global energy-related CO2 emissions and an estimated 50% of global waste (UN, n.d.). A large part of these emissions comes from the transport sector as urban car use relies mostly on burning fossil fuels (ITF, 2018). Therefore, the next chapter addresses the need for a sustainable urban mobility plan by stressing the challenges of urban mobility and the solutions to overcome them.

2.2. Sustainable Urban mobility

2.2.1. The challenge of urban mobility

Mobility is one of the greatest environmental challenges we face today (WWF, 2018). Rapid urbanization together with inefficient transport systems is leading to a rise in car ownership which results in greater congestion and reduced productivity (Lang et al., 2020). So far, governments have addressed urban mobility issues by building more infrastructures, mostly for cars. (UN-Habitat, n.d.). However, without significant action, CO2 emissions will continue to rise since 68% of the world population is projected to live in urban areas by 2050 (UN DESA, 2018). Therefore, to restore vitality to urban areas, authorities will need to focus on reducing carbon emissions (Gopal & Conde, 2021)

Furthermore, the current trends influencing urban mobility, such as shared mobility and connectivity (McKinsey & Company, 2019) gave rise to alternative modes of transport, namely ride-hailing and micro-mobility. However, the overabundance of modes has fragmented the mobility ecosystem urging the need for public and private operators to work together effectively (Lang et al., 2020). Municipal authorities play an important role in integrating and coordinating urban transport solutions which are based on the creation of an on-demand, shared mobility solution (Lang et al., 2020). The following section will introduce the concept of sustainable mobility and its implication on the current transport system.

2.2.2. Sustainable mobility

The concept of sustainable mobility clarifies the need for significant transformation of the prevailing transport and mobility system to achieve long-term sustainability goals. Even though

the SDG framework does not provide a clear outline for mobility, it includes some elements of this sector in various goals. For instance, transport is a primary consumer of fossil-fuel energy thus it is vital for the accomplishment of the goal for affordable and clean energy. Moreover, the goal for sustainable cities and communities is highly dependent on enhancements in road safety and expanding public transportation (Mohieldin & Vandycke, 2017).

To deal effectively with the complexities of urban transport, the European Commission designed the Sustainable Urban Mobility Plan (SUMP) with the core objectives of improving accessibility and quality of life. Contrary to traditional planning, this plan puts greater focus on people, emphasizes modal integration, and points out the need for cooperation between the government and private actors. Since 2013, it has been widely used at an international level (Oyofo, 2019).

The SUMP process gave rise to the concept of Mobility-as-a-service (MaaS) as a potential way to position different players into committing to mobility activity that aligns with achieving the sustainability objectives (Hensher et al., 2021). MaaS is recognized as a disruptive innovation that will change the entire transport system through the integration of all existing transport modes into one mobile service accessible on demand (Whim, 2016). However, public authorities must also be aware that MaaS also implies policy, regulation, and technical elements that go beyond the SUMP method (ERTICO – ITS Europe, 2019). As such, the next chapter will address the complexity of the MaaS ecosystem, stressing the roles of different stakeholders and their interactions.

2.3. Business perspective of Mobility-as-a-Service

MaaS is a highly complex system that involves the integration of various stakeholders from different industries. Therefore, this section will start with a combination of several definitions presented around the concept. Then, it will present the potential benefits of its implementation. Lastly, the definition of MaaS will be extended to the business ecosystem.

2.3.1. Definition of MaaS

No universal definition of MaaS has yet been accepted although it is widely debated by researchers (Jittrapirom et al., 2017). The first comprehensive definition was given in 2014 as "a mobility distribution model in which a customer's major transportation needs are met over one interface and are offered by a service provider" (Hietanen, 2014). Later, König et al. (2016) defined it as "Multimodal and sustainable mobility services addressing customers' transport

needs by integrating planning and payment on a one-stop-shop principle". Furthermore, Reyes García et al. (2019) defined it as a single digital interface that offers consumers the possibility to get from A to B in a flexible, personalized, on-demand, and seamless way. This interface is usually composed of different services such as a booking system, easy payment, real-time information, and an intermodal journey planner that offers different combinations from existing public transport (PT) modes to other modes involving the sharing of vehicles such as bike-sharing (Kamargianni et al., 2015). Therefore, many authors describe MaaS as user-centric, intelligent mobility management and distribution system (Kamargianni & Matyas, 2017; ERTICO-ITS Europe, 2019).

The MaaS platform offers two types of tariffs: "pay-as-you-go" charges users according to the use of the service, and "personalized mobility packages" (Kamargianni et al., 2015) bundles mobility services in a monthly (or yearly) subscription, similar to mobile phone contracts (Hietnana, 2014). Cusumano et al. (2014) argue that the bundle offer provides a great opportunity to integrate PT and shared modes as a single service, which, in the case of telecommunication, has proved to be more competitive than standalone products or services.

2.3.2. Potential benefits of its implementation

There is a growing amount of literature that documents that MaaS is a promising mobility concept, and it is expected to deliver several economic, societal, environmental, and transport-related benefits (Dimitriou & Sartzetaki, 2020) by increasing the sharing of mobility resources, reducing the number of vehicles needed and integrating multimodality (Strömberg et al., 2018). Moreover, it provides an opportunity to decarbonize transport within cities by integrating electric vehicles and reducing the need for private car ownership (Gould et al., 2015). In addition, it may increase accessibility and equity (König, 2016) and provide a better commuting experience (Reyes García et al., 2019).

However, it may also be unsustainable if it competes against PT and active modes (i.e., walking and cycling) (Pangbourne et al., 2020). This may require the offering of a subscription plan as it may encourage users to use PT, whereas the pay-as-you-go option imposes the risk of staying with the current travel patterns (Ho et al., 2020). Furthermore, Farahmand et al. (2021) suggest the design of pricing schemes to persuade users towards public transport (PT) and other shared modes by increasing the cost of other alternatives.

Since MaaS has only started to be adopted recently, the analysis of real-life demonstrations is still limited and, thus, evidence on the potential benefits of its implementation is scarce. (UN, 2020). However, an evaluation in Sweden of the UbiGo pilot, a MaaS application combining PT, car sharing, rental car service, taxi, and bike-sharing services with customized household subscriptions, demonstrated a decrease of private car usage by 50% whereas express bus and local bus usage increased by 100% and 35%, respectively (ITS, 2017).

As already mentioned, the successful implementation of MaaS implies effective coordination and cooperation of several players within the ecosystem, especially among key suppliers. Therefore, to understand the benefits of collaboration it is important to acknowledge the role of each player and the interactions between them.

2.2.3. MaaS ecosystem

A business ecosystem can be defined as a network of organizations that work cooperatively and competitively to support new products, satisfy customer needs, and integrate innovations. (Moore, 1993). The proliferation of digital technology has extended Moore's concept by adding a second tier to the ecosystem: the digital ecosystem that "operates as a peer-to-peer distributed technology infrastructure that creates, disseminates, and connects digital services over the internet" (Senyo et al., 2019). A digital business ecosystem is, therefore, a collaborative environment made of different entities who create synergies between them to generate value (Senyo et al., 2019).

From a business perspective, MaaS can be defined as a digital ecosystem of integrated mobility partners who deliver new services to the end customers and combine various services into high-value offerings through a platform (MaaS Alliance, 2017). The common principle is to deliver a door-to-door seamless mobility experience, and the core function is to catalyze an open and dynamic market (MaaS Alliance, 2017). At this stage of understanding, the main requirements for the MaaS ecosystem are the delivery of a user-central value proposition; a single market with open Application Programming Interface (APIs) to allow data access; a legal environment that enables cooperation and sharing; and lastly, IT systems that provide flexibility and adaptability (MaaS Alliance, 2017).

The project MaaSiFiE (Mobility as a service for Linking Europe) funded by CEDR states that the MaaS ecosystem consists of four different levels: 1) public and regulatory level - contains national road and local authorities; 2) transport and logistics service providers' level - contains

public and private transport services, parking services, and logistics services; 3) mobility service level - contains MaaS operators, third-party technology, and service providers; and 4) end-user level. Moreover, a distinction is made between the supply and demand side, the former corresponding to level 2 and the latter to level 4. (König et al., 2016)

According to a different study, the business ecosystem is divided into three different layers differentiated in line with its degree of significance: 1) the core business, 2) the extended enterprise, and 3) the business ecosystem, illustrated under Figure 1. (Kamargianni & Matyas, 2017).

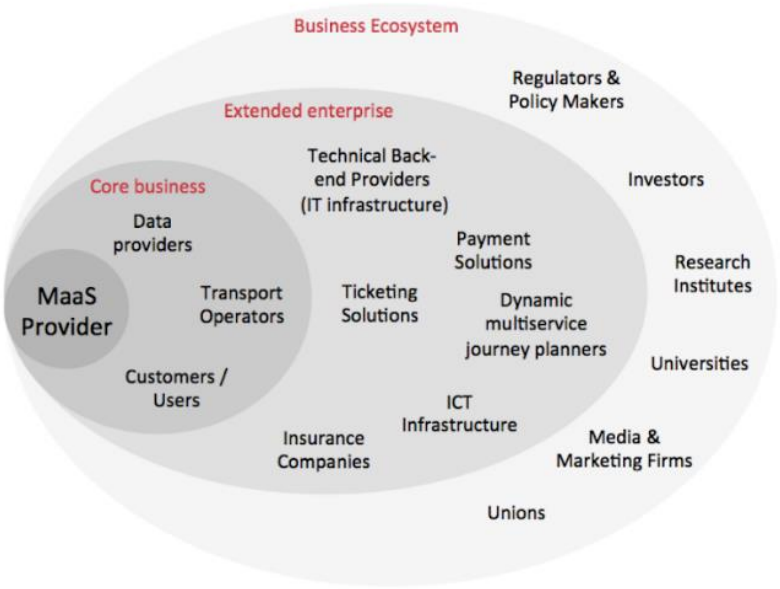

Figure 2: The Mobility-as-a-Service Ecosystem

***Figure 1**- The MaaS ecosystem*
Source: Kamargianni and Matyas, 2017

With the intent to understand the role of each stakeholder within the business ecosystem, the following table presents a literature overview of the most relevant players and their respective roles and responsibilities. Nevertheless, as the MaaS ecosystem evolves other actors could also be added.

Level	Stakeholders	Roles and Responsibility	
Public and regulatory	City/ Local government	- Legislator and regulator - Finance infrastructure investments and design incentives	(Xing et al., 2019; König et al., 2016)
	Public transport authority	- Manage public transport and strategic urban planning - Responsible for local infrastructure usage - Collect useful data	(König et al., 2016)
Supply side	Public transport operator	- Provide routes, fares, timetables, real-time location	(König et al., 2016)
	Private transport operator	- Offer a more inclusive service such as door-to-door, particularly in areas that are not covered by public transport - Provide availability of vehicles	(Xing et al., 2019; König et al., 2016)
	Data provider	- Acts as a data broker to service the data and information sharing requirements of the transport operators and MaaS operator - Offer data and analytics capabilities to MaaS operators	(Datson, 2016; Kamargianni & Matyas, 2017)
Mobility service	MaaS operator/ integrator	- Integrate the existing mobility service providers into a single digital platform and design the MaaS products - Use the data provided by transport operators, buy capacity from them and resell to end-users - Transfer the booking of and payment for the service between both sides - Provide personalized multimodal transport plans, customer service and user experience	(König et al., 2016)
	Mobility service provider	- Provide technological necessities to the MaaS operator and transport operators (e.g., mobile ticketing and payment) - Support to the MaaS operator to develop its own intelligence and platform	(König et al., 2016; Kamargianni & Matyas, 2017)
	Other service providers	- Provider other services (insurance provider, hotel booking, EV-charging company)	(Xing et al., 2019)
Demand side	Customers	- Could be individuals, companies or both - Plan multimodal journeys, books transport assets, receive on-route guidance, and pay for the journey	(König et al., 2016)

Table 1 – Roles and Responsibilities of stakeholders within the MaaS ecosystem
Source: Adapted from the indicated sources

Operating models

As showed in the table above, a MaaS operator/integrator acts mostly as an intermediary between customers and transport operators. According to Mulley & Nelson (2020) there are different possible permutations of stakeholders in a MaaS ecosystem, in which the difference lies in the role of the integrator (private or public entity). It is important to note that the combination of stakeholders is likely to depend on the context and governance framework.

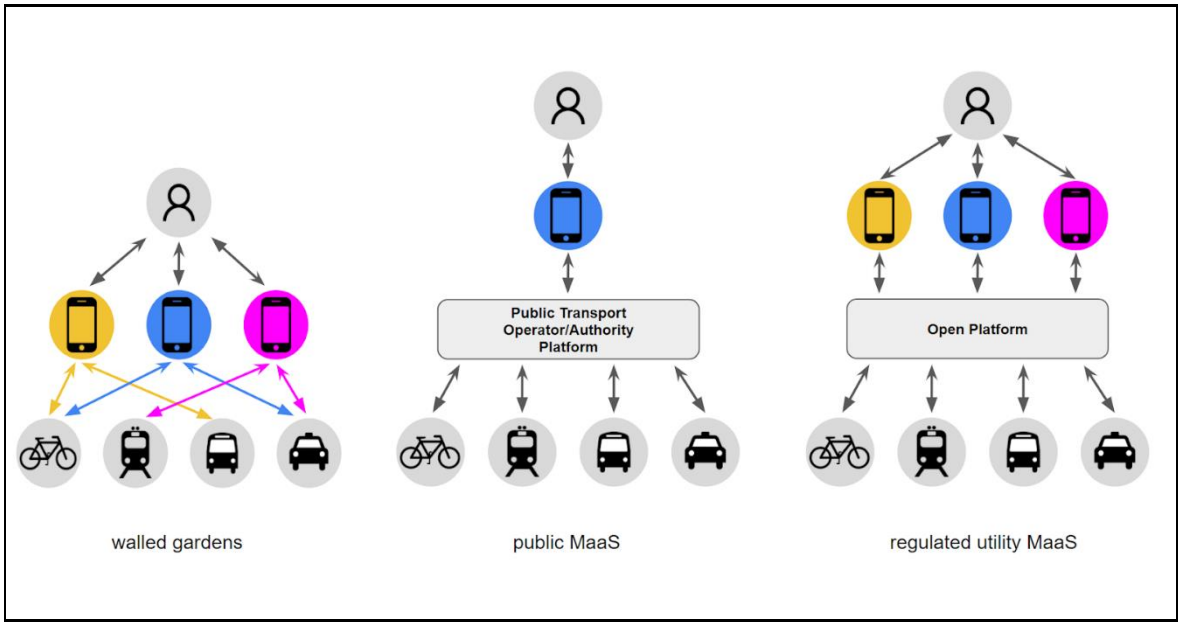

***Figure 2**- Possible permutations of stakeholders in a MaaS ecosystem*
Source: Adapted from Mulley & Nelson (2020)

The formations presented under Figure 2 have three levels within the ecosystem: the lowest levels represent the transport modes and may include other modes besides the ones presented in the figure, the middle levels represent the platform providers/integrators, and the top level is the end-user. In walled gardens, there is more than one (private) integrator whose role is performed on a commercial basis - each one has contracts with different transport operators- and thus, value is created by providing additional services. (Mulley & Nelson, 2020). This sort of permutation has been seen in Singapore (Mulley & Nelson, 2020). In the public MaaS, the integrator role is either taken by the public transport authority (PTA), or the PT operator who is responsible for making the rules, and in between this entity and the end-user lies a platform provider. This model might result in lower competition leading to less innovation and lack of trust (Mulley & Nelson, 2020). This arrangement has been seen in Oslo and Berlin (Mulley & Nelson, 2020). In the regulated utility MaaS, the public authority regulates a third-party platform provider, usually a public entity, that serves as an infrastructure for integrators to choose the mobility mixes to include in their offering. The presence of competition under this model encourages innovation. This arrangement has failed in Sweden and is under development in Denmark (Mulley & Nelson, 2020).

Eckhardt et al. (2017) analyzed existing MaaS services and pilots and reported similar operator model categories: commercial, PT operator, and the Public-Private-Partnership (PPP). The PPP model is defined as "co-operation of some durability between public and private actors in which

they jointly develop products and services and share risks, costs and resources which are connected with these products or services" (Van Han and Koppenjan, 2001). Under this model, MaaS is led by the private sector, and the public sector oversees the performance of the service regarding quality, affordability, and inclusiveness (Hoadley,2017).

Eckhardt et al. (2017) argue that the PT operator model is likely to be more common in cities as these areas are relatively well covered with PT, whereas the PPP model could be more viable in rural areas due to cost savings for the public sector. Nevertheless, the existence of these operation models lies in the development of new business models across the business ecosystem. Therefore, the next chapter will start by addressing the definition of a BM and a SBM from a good logic, followed by the shift to a service-logic, and its relation to the MaaS business model.

2.3. Sustainable business models

2.3.1. Business model definition

The Business model (BM) concept gained popularity during the phenomenon of the Internet (Zott et al., 2011; Magretta, 2002; Richardson, 2008), more specifically with the emergence of e-commerce (Richardson, 2008) as it enabled the development of new BMs and raised the possibility that a better one might give a competitive advantage (Richardson, 2008).

Due to the breadth of this theme, there is no general agreement on its definition (Zott et al., 2011; Richardson, 2008). In simple terms, it is a description of how a firm does business (Beattie & Smith, 2013; Osterwalder et al., 2005; Magretta, 2002) by posing the following questions: (1) What is the product/service offered to the customer? (2) Who is the target customer? (3) How is the product/service created? and (4) How is revenue created? (Gassmann et al., 2013)

These questions are answered under the four elements that constitute a BM: (1) The value proposition specifies the product/service offer and why it is valuable to the customer (Richardson, 2008); (2) The market segment(s); (3) The value creation and delivery system covers the set of activities undertaken by the value chain and the surrounding value network (Richardson, 2008); and (4) The value capture system refers to the way a company makes money through different revenue streams (Osterwalder, 2004). In other words, a BM specifies the benefit the firm will deliver to customers, how it will organize to do so, and how it will capture a portion of the value that it delivers (Teece, 2010).

2.3.2. Business model innovation for sustainability (BMIS)

A firm's need to innovate is a reaction to its business environment, either from an external force like a change in competition, technology, and stakeholders' demand, or an internal change such as an adoption of a new strategy (Foss & Saebi, 2016). As such, business model innovation (BMI) provides an opportunity to deliver a long-term competitive advantage (BCG, n.d.), and can be defined as the process of "business model exploration, adjustment, improvement, redesign, revision, creation, development, adoption, and transformation" (Geissdoerfer et al., 2018, p.406) to find a performance advantage (Santos et al., 2009) and thus, generate superior economic value (Richardson, 2008)**.** Such a process implies the search for the new business logic of the firm (Casadesus-Masanell & Zhu, 2013) by creating new value propositions (Richardson, 2008) or changing the way the organizations and its value network create, deliver, and capture value (Bocken et al., 2014). Lindgardt et al. (2012) argue that at least two BM elements must change for innovation to qualify as a BMI.

BMI is emerging as a potential mechanism to integrate sustainability into business (Jolink & Niesten, 2013), in which rather than focusing solely on customer benefit or shareholder value, it focuses on stakeholder benefit and stakeholder value (Geissdoerfer et al, 2018). According to Geissdoerfer et al. (2018), BMI qualifies as sustainable business model innovation (SBMI) when it aims at one of the following points:

1. Sustainable development or positive, respectively reduced, negative impacts for the environment, society, and the long-term prosperity of the organization and its stakeholders; or
2. Adopting solutions or characteristics that foster sustainability in its value proposition, creation, and capture elements or its value-network

Sustainable business models (SBMs) are thus, defined as "business models that incorporate pro-active multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders, and hold a long-term perspective" (Geissdoerfer et al, 2018). The core of a SBM is a sustainable value proposition (Bocken et al*.,* 2013). From a classical perspective, the concept of value is distinguished between use value and exchange value. The former refers to the customers' subjective perceptions of the usefulness of the product or service being offered, whereas the latter refers to the amount paid by the buyer to the producer (Bowman & Ambrosini, 2000). In the context of sustainability, this logic of profit maximization

is extended to more stakeholders (Pedersen et al., 2018) to also include aspects of social inclusion and environmental sustainability (Bocken et al., 2014). Therefore, the value proposition allows multiple-stakeholder value creation by considering the needs of customers, shareholders, suppliers, partners, the environment, and society (Bocken et al., 2013). However, understanding and managing these needs to create shared value is considered a critical task. (Bocken et al., 2013)

The same logic applies to the value capture element which is usually focused on customer value and monetary value. However, in the sustainability context, it is defined as the benefit delivered to the company and its stakeholders, extending the monetary value to the wider value provided to the environment and society such as improved energy efficiency, zero emissions, and clean production (Yang et al., 2017).

2.3.3. Service-dominant logic perspective

The previous definition of a business model was applied to the classical economic perspective of the good-dominant (G-D) logic in which value creation is performed by the firm and its partners and so the roles of producers and consumers are distinct. However, the growing significance of services emphasize the need for a service-oriented approach to value creation (Bitner & Brown, 2008) giving rise to an alternative view, the service-dominant (S-D) logic. Under this view, the roles of producers and consumers are not distinct as value is always co-created in interactions among providers and beneficiaries (Vargo et al., 2008) Therefore, value is derived and determined in use rather than in exchange captured by price (G-D logic) (Vargo et al., 2008).

Several recent studies apply the S-D logic perspective in a mobility context (Schulz et al., 2021) since automotive companies such as Daimler AG and BWM are adapting their traditional model of car manufacturing to also provide services (BWM Group, n.d.). Furthermore, this shift in logic also takes place on the demand side as the young adult generation is less willing to buy a car than older generations and is more inclined to use app-based mobility services (Schulz et al., 2021)

Therefore, in the MaaS business model, the value proposition, creation, and capture elements happen simultaneously as services are co-created and co-produced in real-time by customers, employees, and technology (Aagaard & Ritzén, 2019). Value co-creation describes the combination of knowledge, capabilities, and resources from all actors (Vargo & Lusch, 2008),

and it is the result of the resource integration and service exchange among them (Vargo & Lusch, 2017). Thus, actors engage in a reciprocal and mutually beneficial relationship.

So far, the literature that address the MaaS Business model has mostly focused on the following topics: revenue sources, operating models, potential mechanisms for value capture, possible organizational schemes (Molinares & García-Palomares, 2020), BM prototypes by the employment of the business model canvas (Polydoropoulou et al., 2020), and characteristics of sustainable business models (Sarasini et al., 2017). Although the last one is the most similar to this research topic, it focuses mostly on the MaaS business model from the platform operator's perspective. Whereas we attempt to investigate the business model of the MaaS ecosystem from the perspective of all actors involved. Furthermore, we analyze the ecosystem business model from a value perspective - value proposition, value creation and delivery, and value capture.

Therefore, in this thesis, we set out to understand the potential of MaaS to deliver sustainable value and the implications that this will have on its business models by answering to the following questions:

1. How can a MaaS ecosystem create, deliver, and capture sustainable value?
    - 1.1 What types of value does MaaS generate, and for whom?
    - 1.2 Who are the key players in the business ecosystem and what is their role?
    - 1.3 What are the interactions between players?
    - 1.4 Which types of value are captured? And by whom?

3. Methodology

This chapter introduces the research methodology of this thesis. It starts by outlining the research approach used to answer the question "How can a MaaS ecosystem create, deliver, and capture sustainable value?". Then, it indicates the sample and method of data collection, and lastly, the data collection process which was split into five steps: (i) Determine what information to collect; (ii) Find and contact industry experts; (iii) Conduct interviews; (iv) Collect data; (v) Analyze data and compare to findings from literature review

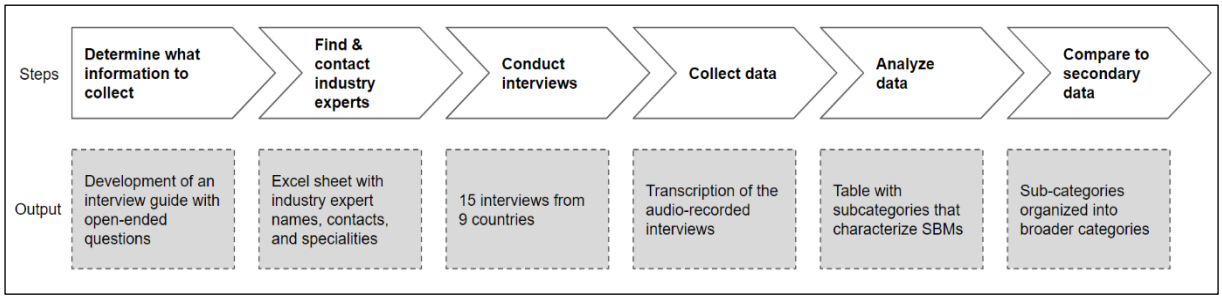

***Figure 3**- Data collection process*

3.1. Research approach

The purpose of this research is to acknowledge the potential of MaaS to generate sustainable value and its implication on the business models. Therefore, the approach followed was inductive because it is applicable when researching an emerging topic that is generating much debate but has still little existing literature (Saunders et al., 2007). Unlike the deductive approach, there is no predetermined theory or conceptual framework to start with. (Saunders et al., 2007). Instead, there is a defined research purpose that will be explored through primary data and later analyzed to develop new theories that will subsequently relate to the findings from the literature review (Saunders et al., 2007).

3.2. Sample and data collection method

The approach chosen suggests the collection of qualitative data (Saunders et al., 2007), in which information is gathered from individuals to identify themes that allow the development of theories. Thus, a qualitative exploratory design was held in which the selected sample population was industry experts. The selection criteria was based on the interviewer's experience in the mobility service field, and preferably experts from different countries to have different perspectives.

Data was collected through individual semi-structured interviews due to its appropriateness for both "how" and "what" type of research questions (Eriksson and Kovalainen, 2011). Furthermore, unlike a simple survey, semi-structured interviews provide the opportunity to 'probe' answers, where the interviewees can elaborate better their responses, therefore enabling the uncover of valuable information based on their experience and perspective on the subject (Saunders et al., 2007).

3.3. Data Collection process

Step (i) Determine what information to collect

The first step was to prepare a semi-structured guide with open-ended questions tailored to the research objective and other concepts derived from the literature review (Appendix I). However, each guide varied in terms of order and/or wording from interview to interview.

Step (ii) Find and contact industry experts

The relevant experts to contact were found through secondary data via a Google engine search and LinkedIn search. As a starting point, the searched keywords were "MaaS Alliance" and "ERTICO-ITS Europe" as they refer to PPP that bring members and organizations representing different stakeholders from the mobility sector. Additionally, other keywords were searched, namely "MaaS expert panels" via google, and "Mobility-as-a-Service", "smart mobility", "smart cities", "green cities", "smart and green mobility expert", and "shared mobility" via LinkedIn. Furthermore, MaaS reports previously found in the literature were used to find authors' names.

The output of this search was an excel sheet with several expert names and respective contacts (Appendix II). Subsequently, each LinkedIn profile was analyzed to understand their relevance in the research topic. As a result, 85 experts were contacted, mostly through personalized LinkedIn InMail (Appendix III). The information provided addressed the purpose of the research and the kind of information to be collected so that interviewers could be prepared in advance. In total, 15 interviews were conducted between November 25th and December 23rd. The experts were currently working in nine different countries, all from Europe except one from the USA. Their roles varied from CEOs to directors and consultants. (See Appendix IV).

Step (iii) Conduct interviews

The interviews were conducted via Zoom for an average length time of 52 min, ranging from 37 min to 68 min. Notes were being taken throughout the interview, and follow-up questions such as “Can you please elaborate?” were asked to better understand the speaker’s intended message. Overall, respondents were allowed free rain if the discussion stayed within the research boundaries.

Step (iv) Collect data

With the permission of participants, the interviews were fully audio-recorded since the recording and accurately transcribing interviews is one of the most ideal methods to avoid inaccuracies and data loss (Canary, 2019). Therefore, data were collected through manual transcription, and afterword were classified into categories whose labels were derived from the interview guide.

Step (v) Analyze data and compare to literature review

The procedure used was a template analysis which is mostly used to analyze interview transcripts (King et al., 2018). This type of analyses implies the development of a coding template which summarizes themes identified as important by the researcher and organizes them in a useful manner. (University of Huddersfield, n.d.). Furthermore, it allows to identify relevant themes in advance of the main analysis (King et al., 2018). As already mentioned, labels were predetermined and then revised throughout the process. Overall, it was an iterative process, in which new categories were created, some were merged, and some disappeared, with the ultimate objective of reducing and rearranging data into a more manageable form. As a final step, the categories were compared to the secondary data under the literature review section to create a guiding structure for the Findings chapter. (Appendix V)

4. Findings

In line with the research question, this section will be divided into two parts. The first part is related to the potential of MaaS to deliver positive benefits to society. The second part is related to the business model of the ecosystem which is divided into its four elements: sustainable value proposition, customer segments, value creation and delivery, and value capture.

4.1 The potential of MaaS to deliver sustainable value

Industry experts argued that for MaaS to create a more environmentally friendly transport system it must improve the resource efficiency of the current system by (1) reducing the number of material inputs such as road infrastructure and vehicles and (2) minimizing the impact on raw materials to create the necessary vehicles. These results depend on the ability of MaaS to replace privately-owned vehicles with services that allow the end-user to have the same service level as with his or her private car. Therefore, to compete with this mode, MaaS must be as easy to use, which translates into good accessibility, convenience, reliability, and a friendly application. This requires the integration of car-sharing companies as they can offer the same comfort and space as private cars, and reach areas not covered by PT. However, most experts stated that users must favor mainly walking, PT and bicycle-sharing schemes, as these are the most sustainable modes. Nevertheless, Expert I (MaaS Alliance member, The Netherlands) argue that micro mobility is not necessarily a good thing because it is always individual and to truly achieve sustainability we should aim at collective and combined mobility. In other words, increase vehicle occupancy.

4.2. MaaS ecosystem business model

In this section we state the findings in relation to the business model of the whole ecosystem, starting with the benefits that MaaS promises to each stakeholder, what implications this has in the value creation process, and how can each stakeholder capture part of the value created.

4.2.1 Sustainable value proposition

The sustainable value proposition refers to the value MaaS promises to deliver to each stakeholder if they choose to be involved. Therefore, it is essential to understand the benefits that this will bring to all the parties. According to industry experts, the interested parties are the end-users, society, environment, transport operators, platform operators, city/local government, and public authorities.

End-user value

Currently, end-users need to use several tools to find and purchase transport modes and find information related to mobility such as traffic. In addition, they need to use different payment methods, which deteriorates even further mobility. MaaS is a solution that removes these pain points by offering a better level of service which is affordable, flexible, convenient, customizable, and personalized. Furthermore, it contributes to a healthier lifestyle and can make users feel good for contributing to the overall sustainability of the planet.

Public value

Concerning social value, MaaS promises social inclusion which translates into improved access to job opportunities and other needs such as education and health assistance. Moreover, MaaS aims to lower congestion, which leads to less noise, and better air quality, resulting in fewer health issues. In addition, more public space will be made available for other uses that benefit citizens. Regarding the environment, the positive effects from MaaS are translated into reduced emissions, reduced waste, reduced pressure on natural resources, and increased green areas.
Furthermore, MaaS enables the City/ local government to organize mobility in a more coordinated way and could also contribute to a more effective redistribution of the government's mobility subsidies. Moreover, it is an opportunity for the government to achieve policy goals, such as reduced congestion, decarbonization, and accessibility. From the public authorities' perspective, it provides resources and data to meet the needs of citizens and can be a powerful tool to implement strategies that are in line with enabling more sustainable mobility.

Private value

In terms of private value, transport operators are given a new sales channel to capture more users and therefore increase vehicle occupancy resulting in a more effective use of resources. Furthermore, being digitally present increases their service visibility and might enhance the brand image from being associated with sustainability. For platform operators, MaaS is a new business opportunity in which apart from integrating existing transport operators, other services can be added to find new revenue streams (e.g., entertainment).

4.2.2. Customer segment

The sustainability of a MaaS BM in terms of profit generation is highly dependent on its ability to attract the segment of private car users. This is a clear shared strategy within the ecosystem because it is the only way for MaaS to scale. Moreover, there are three types of users: (a) users who will never give up their private cars, (b) users who use PT on a daily basis and thus are already customers, and (c) users who use a mix of modes (private cars, PT and possibly others)

and this is the segment with the potential to be lured. However, as we are currently in a period of introduction, many experts believe it is crucial to target the early adopters' segment which is composed of consumers who are used to the new paradigm of accessing services instead of owning assets. These are typically younger segments who are not so emotionally connected with the car and thus, there is potential to make a complete change (i.e., below 30/35 years old).

Furthermore, since different users have different requirements, experts argued that MaaS must target different segments, such as tourists, employers, and the elderly, by providing different versions of the platform which will also require different value propositions. The B2B model was reported as a segment with great potential to be economically profitable. Several experts mentioned the importance of the corporate segment, in which employers desire a more sustainable commute for their employees. Thus, instead of leasing company cars, they could enter into agreements with MaaS providers and offer a monthly pass to their employees. This way, MaaS would target commuting traffic and companies could achieve their sustainability goals. In addition, peer to peer (P2P) was also emphasized as a crucial model to target car owners, mainly in western Europe. Many experts gave the example of people sharing different types of assets in the neighborhood and charging according to usage. However, although these are some ideas of possible segments to target, the scope of this study focuses solely on the passengers as the customers.

4.2.3 Value co-creation and delivery

The logic of MaaS is to provide customers with the adequate device to make the type of journey they need instead of using the car for every journey. For instance, the need to go to the hospital requires a different mode of transport than the need to go out with friends. However, the potential to deliver this kind of service and thus, create the benefits promised under the value proposition, will require actors to cooperate by integrating their resources and sharing knowledge and information. Therefore, to better understand the importance of each actor we will start by analyzing each role, and afterward the relationships within the ecosystem.

4.2.3.2. Actors and roles

Experts considered the main stakeholders to be the actors who are managing at the public and regulatory level followed by the operators that provide the service. However, for this research, we will include other players that, according to some experts, are essential for the sustainability of MaaS.

(i) Public and regulatory level

Government

Overall, experts argued that the main responsibility of the government is to create policies that ensure operators open their ticketing systems through APIs; provide incentives for the desired behavior; and better distribute the public subsidies. To achieve decarbonization goals the government should provide grants for energy-saving solutions and increase tax benefits for cars that emit less carbon dioxide. To achieve social inclusion, the government should provide subsidies for private companies to operate in areas where the population is not so dense and is not covered by PT. Moreover, in the long run, many experts believe that there will be a more PPP where the financial composition that is going right now to PT will be split between both sectors because both are being integrated into one public system in which margins are low.

> "*PTs are loss-making because they don't have a logic of money but a logic of service*" (Expert N, Future Business Technology Director at CEiiA, Portugal)

> "*I am a full believer that at one moment the public and private will have to make a good compromise on both sides to serve the service because it's a public service*." (Expert O, International sales director at Instant System, France)

Public transport authorities (PTAs)

From a bigger perspective, PTAs are responsible to oversee the transport and mobility of citizens and ensure that it is as sustainable and equitable as possible. With the emergence of MaaS, their role shifts from being at the top of the value chain, in which they procure the services, and deliver them to the users, to being part of an ecosystem with resellers of their service. Under this new reality, industry experts argued that PTAs have the most important role in steering the deployment of MaaS locally since they have the ability and right to start making trade-offs (e.g., creating car-free streets appropriate for micro-mobility space), and to enable a modern and digital public transport offering. Moreover, PTAs are in power to set conditions for transport companies to operate within cities, and to intervene whenever they see market distortions or that it is leading to less sustainable outcomes. In fact,

> "*Uber was active in Brussels and has now been banned because there are too many negative side-effects from the monopoly game they want to play*." (Expert B, Ex-member of MaaS Alliance, Belgium)

Overall, experts agree that cities should act as enablers, whose role is to open the same playing field for everybody. This implies PTAs to allocate money and resources from infrastructures used by private vehicles to infrastructure that facilitate the use of mobility services, such as bike lanes and EV charging spots. Expert F (CIO at ITS Finland) stated that:

> "*There is no need for new money, they have the money already, but they just need to make the political decision to support other infrastructure than the car infrastructure that is currently dominated (...) we already have the data that supports this kind of investment plans*."

Moreover, PTAs should have an ongoing debate with stakeholders to listen to the problems and challenges brought up by them and come to solutions together. According to Expert F:

> *"Usually, the problems are not related to a lack of investment somewhere, but it will be for example that you need to change how city officials interpret certain regulations, or how they discuss with each other, etc."*

(ii) Supply-side

Suppliers - tier 1 and 2

Expert E (Partner at EY, USA) argues that the suppliers (more specifically tier 1 suppliers) are the ones who provide the biggest value because a lot of the innovation seen in the market claimed by vehicle manufacturers came from suppliers

> "*The true innovation power, the ability to create sustainability, to realize ambitions is actually lying at the supplier base, let more so than in the vehicle manufacture base*" (Expert E, Partner at EY, EUA)

However, suppliers are also dependent on what the OEMs ask them to deliver, so there is a little bit of a chicken and egg problem. Nevertheless, if OEMs want to deliver a sustainable value proposition, they must take into consideration the parts and components of their vehicles. Industry experts believe that they will eventually come up with solutions for material recirculation, but it will take some time as it takes about 7-10 years for a full vehicle lifecycle to go through and about 20 years to steer a company into a new direction.

Original Equipment Manufacturer (OEMs)

Several experts argued that although the current role of OEMs is to produce assets, in the following years it will be crucial for them to transform from pure production to tech companies. However, this adaptation will not be easy as it requires a change in terms of mobility thinking and in terms of technology. OEMs will have to acknowledge that vehicles are going to be manufactured and sold in a completely different way. Until now, they used to be sold to a person who ought to create an identity and thus developed a psychological connection with the car. However, it will become more focused on the city and citizens' quality of life and thus, starts to be thought of in larger fleets. This new reality also brings the opportunity for new players to emerge in this area because the thinking capacity of the OEMs is not the same. "*We see how disruptive Tesla is in terms of technology, and uber in terms of mobility*". (Expert G, Director of mobility, automotive and cities at CEiiA, Portugal)

Furthermore, in the MaaS ecosystem, OEMs will tend to position themselves as service operators or even MaaS solution providers, as in the case of Mercedes, and BMW. According to Expert G:

> "T*hey tend to be everything because they have been everything, they completely dominate the roads, and they want to keep this dominant role in the market but it's not easy*"

Transport operators

Experts agree that the backbone of MaaS is PT because it is the only mode with the ability to transport the mass (i.e., a volume of people). The other fundamental piece is soft mobility (i.e., sharing modes) as the PT alone cannot fulfill the needs of all citizens. Therefore, the decarbonization of cities is highly dependent on the combination of both modes. Moreover, some experts argue that private transport operators have the responsibility to the city and its citizens in ensuring that their devices are put in the right place to avoid, for instance, abandoned scooters in pavement areas. However, other experts argue that this is the responsibility of the government.

(iii) Mobility service level

Platform operators/integrators

The platform operator has the responsibility to integrate the existing transport modes into one digital interface and recommend to customers the best option personalized to their needs. Therefore, it needs to attract and acquire new partners, as well as manage the amounts of data available to plan journeys and optimize operations. Expert D argues that the integrators have the biggest impact on sustainability because they are the ones who take the interests of every part:

> "*He needs to work with the city, PT companies, private transport companies, provide the most sustainable mode of transportation that is good for end-users, keep suppliers happy and keep the government happy because otherwise he is banned*" Expert B (Ex member of MaaS Alliance, Belgium)

There is not a general agreement regarding the adequate actor to take this role as it depends on the city's number of transport operators, the quality of PT, etc. Nevertheless, some experts argued that the whole ecosystem should be governed by PTAs, otherwise there is a concern that the integrator will be more inclined to promote the modes that generate the highest margins which are ridesharing and car-sharing. Expert C gave the example of the USA, where a private company is responsible for the transport services, and this is leading to costs associated with environmental and social problems (e.g., traffic jams). According to another expert, a PTA could make sense when bundling all types of public transport and bike-sharing companies into

a monthly pass, however, it gets complicated to integrate more modes such as car-sharing as the public actors are not good at being agile, experimenting with new business models, and creating creative contracts with suppliers.

Furthermore, Expert C stated that in the case of the PTA being completely in charge of the whole ecosystem like in Berlin, it could be good for the end-users as public objectives are a priority, however, there is a great amount of risk associated because it is a completely new business area that is being funded with taxpayer money without any evidence that it can be financially feasible.

> "*Since PTAs are endless pockets, this eventually leads to a process where there is no evolution. Whereas if authorities only create the market conditions for private companies to appear and respond to customers' needs, the private sector should be the one to invest because they have the money and are willing to take that risk.*" (Expert J, Chief Impact Officer at ITS Finland).

Therefore, private companies will have the incentive to evolve all the time to protect their business from competitors. In addition, the integrator must be very close to the customer which requires a different type of knowledge that the public sector does not have.

Overall, experts agree that the best scheme would be somewhere between those two extremes, Berlin vs. USA, in which the public sector takes care of enabling a modern and digital public transport offering and leverages data to better manage mobility. Whereas the private sector is given a good level playing field for providing their services and be profitable in the long run.

(iv) Demand-side

Employers

Many experts emphasized the important role that employers have in driving the change in behavior because car traffic is mainly generated by commuting traffic, therefore if MaaS aims to be a solution it must target problem areas. Expert O (International sales director at Instant System, France) argued that employers are a big part of the value chain:

> "*Most of the time the traffic jams are in the morning when people go to work, and in the evening when people come back from work, so the employer is a big part of the solution (...) If we don't embark the employer in the equation of mobility we are going to fail*"

According to this expert, a lot of mobility projects start with the city doing its part on the side and only afterward gathering the different actors of mobility for debate. However, it is too late because those actors were not in the co-development of the service. Thus, it is fundamental to have all actors involved right from the beginning.

4.2.3.2. Relationship between actors

The co-creation of sustainable value among the different actors will be based on a relationship of collaboration and competition. All actors need to be involved in the early discussions to develop more flexible governance structures and partnership models such as data-sharing agreements and common APIs that enable each actor to create and capture value. Moreover, as transport operators are inserted in one app, naturally there will be competition between them, especially the ones providing the same mode, but in the end, their biggest competitor is the privately owned vehicle.

Collaboration

In general, experts argue that the creation of a more holistic transport service that covers all or most of the citizens' mobility needs depends on the integration of a variety of modes. As Expert G (CIO at ITS Finland) stated:

> "*PT operators cannot increase the usage of PT with the same old methods they have been using in the past years. (…) They need the resources and capabilities of private transport operators*"

PTAs and PT operators realize that there are many other useful and popular options that must be aggregated into the offer and that they do not own the capability to operate those offers themselves. It is not their strength and would require a huge amount of investment. Therefore, the private transport operators are essential in assisting areas where the PT is not able to serve mobility needs.

Furthermore, as PTAs have the power to set conditions in a city, eventually private transport operators will have no choice as cities will require them to be integrated into the platform. Therefore, it is advantageous to cooperate with PTAs and other service providers before somebody else starts the cooperation and then cannibalizes their business. "*If you don't disturb your business someone else will*" (Expert G, CIO at ITS Finland). In addition, most private operators are not structured to provide all the solutions a customer needs. They need to work in a context where transport capacity is limited (e.g., not enough road space), therefore it must be rationed which goes back to the public sector. This enhances the importance of debate between private and public actors about how they are going to run the services within a city. "*In the end, if both sides do not work together, you're going to get market failure"*. Expert M (Director at Stratageed Ltd, UK)

Concerning the relationship between transport operators and MaaS operators, they should work together with price models, come up with solutions to try to increase vehicle utilization, and

make the service more cost-effective. For instance, shared car companies could have more cooperation between leasing, rental car, and car-sharing so that the same car can be used in different BMs. *"It's not technical innovation, it is really about BM and cooperation model where innovation needs to be"* (Expert K, Former CEO and founder of UbiGo, Sweden). Another relevant aspect mentioned by experts has to do with possible synergies between micro-mobility companies. These companies incur high capital and operational expenditures and therefore their BM is cost recovery – make a high investment up front and start operating to have the investment back by either charging as much as possible or reducing costs. Currently, there is a big fragmentation in the market but in the future, the trend is for operators of the same vehicle mode to merge and that is already happening with scooters companies.

Overall, experts agree that the biggest value from collaboration lies in leveraging the power of data analytics. "*The heart is the mobility service, and the blood is the data which is what you need to transfer the oxygen to all the muscles of the mobility*" (Expert O, International sales director at Instant System, France). According to this expert, public and private operators need to have each other's information to optimize the operation,

> *"If a bus has an accident or is going to be late, the platform operator needs the information to find a solution and replan the operation due to this unexpected event"*

This will require operators to open their APIs, and by doing so, they are creating value for end-users by enhancing their experience through the provision of accurate and consistent information that allow them to compare different transport options and make efficient travel decisions.

Besides the optimization of operations, there is a great amount of data to gain from the services, namely insights regarding how customers are using different services and how they are reacting to the various business propositions that are being offered. These insights are useful for cities and public authorities but also for companies who can provide more cost-effective and environmentally friendly services that are constantly developing and upgrading themselves (e.g., adjust pricing model), and thus, getting better than the private-owned cars. Expert D gave the example of MOIA, a shuttle bus service from the Volkswagen group which works in partnership with cities and local PT companies to develop its IT-based on-demand service. The group is currently losing money, but it is not a problem for them because they are gaining valuable data insights on how those buses should move, how they should support the PT system, and how PTAs are reacting. As a result, they are learning how to tailor these services to suit

very wide-ranging needs, and how to offer a much broader scope than at present, which will be beneficial for the upheaval of autonomous vehicles.

However, most of the experts emphasized that data is only as valuable as the companies or entities are willing to pay for it. Thus, its value will depend on the act and skill of who owns it, and what insights they can get from it. Otherwise, it is useless. Moreover, there is no standardization of how this process is done, so there is not yet a structured and meaningful way of systematically collecting the data from the operator.

Competition

Experts argued that competition is a good thing as it enables constant development and, in the end, more options and better service for the end-user. Under this reality, innovation will be key for platform and transport operators to add value. They should innovate by targeting specific segments and differentiate in the types of vehicles offered. For instance, a car-sharing company could target the family segment by providing larger vehicles and communicating the safety and comfort features, whereas another company could target the luxury segment and enhance other types of value. The same logic applies to micro-mobility companies, in which operators may differ in terms of performance (e.g., a faster e-scooter) or in other features related to design, for instance (e.g., feminine e-scooter). At the end of the day, experts agree that there is a great opportunity to create added value by focusing on different segments' needs and wants, as well as the different situations in which people need transport.

Furthermore, it has been proven by many studies that everything which is ride-hailing is a pure competition to all sustainable modes including PT because this service normally operates door to door, and does not integrate other modes in a journey, as taxi does, for instance.

4.2.4. Value capture

All the actors that are involved in the co-creation process should capture part of the value created, which can be either in monetary or non-monetary forms.

End-user value

For the end-user to capture the value of his/her sustainable choices, the amount of CO2 emissions avoided should be quantified and then turned into credits. Expert N (Future Business Technology Director at CEiiA, Portugal) gave the example of a platform that is currently being tested to help cities accelerate the process of decarbonization. This platform is integrated with mobility platforms to quantify customers' mobility in terms of co2 reduction, or in other words,

emissions avoided. This number is then integrated into a digital currency which has two features: (1) will work as a carbon credit that can be exchanged in local markets either by purchasing green products or by receiving free rides, for instance, and (2) connects to the carbon market, that already exists, where users can trade their carbon credit with companies that need to offset their activities. As a result, the user can make some money on the side by changing his behavior. In this specific example, several types of value are being captured at the same time, and according to this expert, a lot can be done around this.

Another way users will capture value is by saving money and time, as they will not have to pay for car insurance, maintenance, gasoline, etc. Furthermore, in the long run, users will end up capturing all the benefits that MaaS delivers to cities in general - from less congestion to better air quality.

Public value

From the city/government perspective, the value of turning cities into more attractive and livable places will be captured through a return on investment - by attracting foreign investment and fostering economic development-. Furthermore, there will be an increase in public space, especially from the reduction of parking spots, that can be used for other purposes such as building new apartments, or even creating green areas to absorb CO2 emissions from the atmosphere. Moreover, in the long run, the allocation of money to infrastructures that support services will have a positive impact on citizens' health which translates into fewer people needing assistance, and therefore value is captured through fewer costs for the health administration.

Private value

From a business perspective, platform operators can capture the value created to end-users in the form of revenue streams collected through two pricing models - a subscription plan or a pay-per-use option - and then redistribute part of the value over the different transport operators in their network. Some experts argued that the pay-per-use option will incentivize more the change of behavior for price-sensitive customers as one km in PT is cheaper than one km in ride-sharing vehicles. On the contrary, other experts argue that by bundling services, the integrator is working with price models that have the potential to attract customers, and thus, it is creating value for both the supplier and the customer. "*They're not just reselling things without adding value, in this sense they're making the service easier to use and a more effective distribution chain*" (Expert K, Former CEO and founder of UbiGo, Sweden). However, other

experts argued that both options have the potential to create sustainable value because they go for completely different target groups - subscription is for regular users and pay-per-use for occasional users.

In addition, transport operators can capture the social value of targeting unmet needs by an increase in market share which translates into more revenue streams. Moreover, they can increase customer loyalty through the digitalization of services which provides more information to customers and thus it becomes a reliable service, especially in the case of PT.

Overall, experts argued that it is hard to make high margins under the MaaS model because it is a right for citizens, and as such the priority is not to serve those who can afford the service, but to enable an accessible offering for every single person. In the specific case of bike-sharing, Expert N (Future Business Technology Director at CEiiA, Portugal) stated that the maintenance and operation costs are so high that there are only two options to earn revenue, either it is paid by a sponsor, or it is subsidized.

5. Discussion

Businesses are increasingly recognizing the important role they have in achieving SDGs (PwC, n.d.), probably due to the increasing pressure for the economic system to drive towards a sustainable system, whose features are presented under Chapter 2 (Section 2.1.3). This type of system matches the features of the MaaS concept which is pointed out as a potential solution that aligns different players into achieving the SDGs (Hensher et al., 2021). However, the interviews reveal that to attain these objectives, MaaS must create a more environmentally friendly transport system by reducing the number of material inputs (i.e., infrastructures and cars) and minimizing the impact on raw materials. This will depend on the ability to replace privately owned vehicles by more sustainable modes which implies the integration of public transport and shared mobility such as car-sharing, ridesharing, and bike-sharing (CIVITAS, n.d.). However, according to Expert I (MaaS Alliance member, The Netherlands) bike-sharing is not necessarily a good thing because it is individual mobility, and the aim should be for collected and combined mobility.

A SBM is defined as a "business model that incorporate pro-active multi-stakeholder management, the creation of monetary and non-monetary value for a broad range of stakeholders and hold a long-term perspective" (Geissdoerfer et al, 2018). Therefore, we will analyze each dimension of the BM to understand what are the implications that enable the creation of sustainable value.

Value proposition

According to the MaaS Alliance (2017), MaaS aims to become the best value proposition for both individuals and business users. However, in the context of sustainability, the value proposition must also consider the needs of suppliers, partners, the environment, and society to allow multiple-stakeholder value creation (Bocken et al., 2013) and thus, extend the logic of profit maximization to also include aspects of social inclusion and environmental sustainability (Bocken et al., 2014). Therefore, we argue that the design of the value proposition should be a collective work that involves the input of several players to align everyone's needs and solve conflicting interests from early on. In this process, multiple value propositions should be created to target each stakeholder (including society and the environment). This will contribute to a better understanding of each player's role in creating shared value. However, the delivery of these benefits is not only dependent on the role and interactions between players but also on the existing business models that MaaS builds on. As such, we argue that value creation also

depends on vehicle suppliers, OEMs and operators who should innovate their existing BMs to integrate sustainability objectives

Customer segments

The interviews reveal that in the short-term, MaaS should target the early adopters' segment which is composed of consumers who are used to the new paradigm of accessing services instead of owning assets. This goes in line with the findings from the literature review that mention that the young adult generation is less willing to buy a car than older generations and is more inclined to use app-based mobility (Schulz et al., 2021). However, to be profitable, in the long run it must attract the segment of private car users.

Value creation

Findings from both the literature and the interviews considered the government, PTAs, and transport operators as key stakeholders. However, neither referred to the active role of customers in the value creation process. Under the S-D logic presented in Chapter 2 (section 2.3.3) value is always co-created in interactions among providers and beneficiaries (Vargo et al., 2008) by combining the knowledge, capabilities, and resources from all actors including customers (Vargo & Lusch, 2008). Therefore, we believe that customers play a key role in the early phases by experimenting prototypes and delivering feedback, but also during the use of the service by systematically providing information (e.g., how crowded a bus is). In addition, the literature barely mentioned the role of the employers, although some experts argued that they also play an active role in the co-development phase as they are targeting commuting traffic. Therefore, we argue that both the end-user and the employer should be included during the value creation process because it helps to increase acceptance and minimize the risk of failure.

Concerning the platform operator, opinions diverge regarding the most adequate entity to take this role. As stated in the literature and mentioned by experts, there are three types of operating schemes: public, private, and PPP. Whereas in literature authors argued that the most adequate scheme in cities is the public model, most industry experts believe that it will be a PPP model where the public sector is responsible to (1) ensure that policy goals are attained, (2) enable a modern and digital PT offering, and (3) use data analytics generated by the service to better manage mobility. While the private sector takes care of operating the platform and providing added-value services. We strongly believe that this is indeed the best scheme because each player is taking a role that matches his capabilities. The public sector doesn't have the know-

how to compete with tech companies such as Uber, and to compete with the perceived convenience of a private car which requires the creation of a user-centric service.

Furthermore, there is a lack in the literature regarding the roles of vehicle suppliers and OEMs within a MaaS context, probably because they are not directly included in the value creation process. However, some experts stated that they have a key role in achieving environmental sustainability through their production systems. Going back to the sustainability principles mentioned under Section 2 (2.1.2), we argue that suppliers should replace rare materials (e.g., Lithium) for nature's materials, generate less waste, and use 100% renewable energy in manufacturing components for vehicles. Even though electric vehicles do not cause any air pollution, it does not necessarily mean that they do not produce CO2 emissions. In fact, according to Sibelga (n.d.) an average of 60% of the electricity produced in the world comes from coal and gas (i.e., fossil fuels). This proves that the way the electricity is generated is an important factor to consider if MaaS aims to deliver environmental value. Nevertheless, this demand should come from OEMs who should be responsible for the ecological performance of the whole vehicle lifecycle (from supply to the recycling of components).

Value capture

Findings from the literature review focus mostly on the monetary aspect of value capture, by giving emphasis to the subscription model as an important mechanism to incentivize a change in behavior (Ho et al., 2020). However, the expert's opinions diverge regarding the best option. Some argued that the pay-as-you-go option has also potential in changing behavior, mainly for price-sensitive consumers, since one km in a PT is cheaper than one km in a car-sharing ride. Whereas others argued that by bundling services the MaaS operator is adding value to both customers and suppliers. Nevertheless, it was surprising to find that experts believe it will be hard for MaaS to make profit because that is not the logic of a public service, in which the priority is to create social and environmental value. Moreover, micro mobility companies have high operational costs which could mean that the government will have to end up subsidizing it. But it also might be that companies are able to recover the money invested either by diversifying or adding value to their service.

Furthermore, in the sustainability context, the value capture is defined as the benefit delivered to the company and its stakeholders, and thus, includes both monetary and non-monetary value (Yang et al., 2017). The interviews revealed that there are vast opportunities for the city/government, in the long run, to capture monetary value by a return on investment for

making cities more attractive, and by incurring less costs in the health assistance of people. Another interesting finding was the creation of platforms that quantify the CO2 emissions into credit, which could serve as a powerful incentive to change behavior. Lastly, several experts emphasized the increase in public space, especially form the reduction of parking spots, that could be used for other purposes such as building new apartments, or even creating green areas to absorb CO2 emissions

To summarize, these findings reveal that MaaS has indeed the potential to deliver sustainable value. However, it depends on its BM. First, multiple value propositions should be designed with the integration of stakeholders' input to align everyone's needs and avoid conflicting interests. Then, the roles within the business ecosystem should be clearly defined so stakeholders are aware of the different roles that contribute to creating shared value - employers and customers should be involved in the value creation process to increase acceptance and minimize the risk of failure; the private sector should take the role of the platform operator because they have the capabilities and know-how to create user-centric solutions, and the public sector must enable a digital PT offer. Furthermore, suppliers and OEMs must innovate their current BM to respect the sustainability principles mentioned under Chapter 2 (Section 2.1.2) and to achieve the sustainable economic system mentioned in Section 2.1.3. Regarding value capture, all stakeholders that engage in the value creation process should be able to capture both monetary and non-monetary value.

6. Conclusion

In summary, the aim of this research has been to understand the potential of MaaS to deliver sustainable value and the implication that this has within its business models. As such the research question "How can a MaaS ecosystem create, deliver and capture sustainable value?" was explored by a combination of secondary and primary data. We conclude that the sustainability of the MaaS business model is dependent on three factors: (1) the ability to capture the segment of private car users to be profitable in the long-run (2) the extension of the PT network with other forms of collective mobility (i.e., car-sharing) to achieve social inclusion (Hoadley, 2017), and (3) the BMI of suppliers and OEMs to integrate environmentally sustainable objectives. Achieving these points will depend on the following conditions:

From a public and regulatory level, the government needs to create a regulatory framework to bring order to cities and allow the same playing field for every actor, without trying to create a monopoly. In addition, the government should redistribute subsidies between both sectors as an incentive for private companies to meet social and environmental objectives. Concerning transport authorities, their main role is to act as enablers by allocating investment to infrastructures that enable the use of services. In addition, they should gather all stakeholders, including employers and end-users to discuss possible problems and derive potential solutions from the co-development phase of the service.

On a supply-side level, OEMs need to demand suppliers to replace rare materials with nature's natural resources and to use 100% renewable energy in manufacturing components for vehicles. Furthermore, they should be responsible in recirculating materials to contribute to a closed-loop system where nothing gets wasted. Concerning transport operators, the public sector needs to digitalize its current offer and improve its service to better match the end-user's expectancy, whereas the private sector should complement the existing PT network by targeting all end-users, regardless of their purchase power. In addition, they should leverage the market heterogeneity and find niches to create added value and therefore, differentiate.

On a mobility service level, platform operators must prioritize walking, PT, and micro mobility modes in their offers to consumers, which will mostly come from incentives given by the government. Furthermore, they must work with transport operators to experiment new business models by developing creative revenue models with the aim to increase margins. In, addition, data providers are essential in delivering data analytic capabilities for both operators and cities.

This requires all transport operators to open their APIs to also enable the essential functions: ticketing, planning, and booking.

Lastly, on a demand-side level, end-users, and employers (who target end-users) will be two key players during the value creation process by providing continuous feedback on the services.

In the end, if every stakeholder knows his role and does his part, everyone will be able to create and capture all three types of value – economic, social, and environmental: The environment will gain from a reduced of non-renewable resources, virgin materials use, and waste. Society will gain from better air-quality, more green spaces, better accessibility, and social inclusion, which translates into a better quality of life for end-users. End-users will gain by saving costs and time, and will earn money based on their sustainable choices. Governments will achieve policy goals, attract foreign investment, and foster economic development. OEMs will capture value by a reduction in production costs from reusing components. Transport operators will gain from an increase in market share, new revenue streams, resource efficiency and customer loyalty. And lastly, platform operators will capture value in the form of revenue streams.

In the short-term, we recommend MaaS actors to invest in marketing and communication campaigns to create awareness and educate consumers on the sustainable benefits of MaaS in relation to a private vehicle. The benefits emphasized should be accordingly to what each segment values (e.g., price sensitive consumers vs. environmental-conscious consumers). The reality is that the arrival of ICT is giving us the opportunity to steer in a new direction whereby human activity respects the earth's boundaries. At the end of the day, the main stakeholder who can drive this change are the end-users, therefore it is crucial to incentivize a change in behavior.

This thesis contributes to a holistic understanding of the MaaS SBM by presenting it from the perspective of key stakeholders. This could facilitate the acceptance in collaboration. In addition, we give relative importance to the role of vehicle suppliers and OEMs in creating environmental value. These findings could be used as an initial set of ideas for future practitioners to further explore each value dimensions as well as each player in more detail. It could be interesting, for instance, to explore the B2B relationship of MaaS and the corporate sector. Moreover, as changing consumer behavior is fundamental, different incentive schemes (e.g., gamification) is also an important topic to analyze.

7. Limitations

Due to time limitations, this research was mostly focused on the value creation dimension and not so much on the value capture. In addition, under the value proposition we focused on the benefits of each player collaborating, and did not cover their concerns, in other words, the costs of collaboration (e.g., loose direct contact with customers).

Furthermore, interviews were limited to industry experts, whereas to gain more depth to the research it would be interesting to interview public authorities, OEMs, transport operators and platform operators as their points of view may differ.

In addition, as the industry experts were mostly from Europe, the findings are based on the European context. Therefore, it might not be applicable for other continents. However, even in Europe it is important to consider that the right solution will differ from market to market according to all the factors that create that market (e.g., economic, political, social).

Lastly, even though the study aimed at uncovering empirical experiences, the novelty of the concept and the lack of in-life demonstrations made the results somewhat speculative. Therefore, conducting the same analysis in a later phase when the market is mature, could deliver more accurate and reliable insights

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Appendix

Appendix I: Industry Experts Interview Guide

Interview Guide
1. What is your understanding of sustainable value?
2. What types of value does MaaS generate? And for whom?
3. Do you believe there is a crucial segment to target?
4. Who are the key players in the value chain and what is their role?
5. What is the relationship between players?
6. What are the value transactions between players? (Data, knowledge, money)
7. What potential synergies may arise?
8. How can transport operators differentiate?
9. Which types of value can be captured? And which actor/s can capture that value?

Appendix II: Illustration of List created to contact industry experts

Name	Status	Organization	LinkedIn	Occupation	LinkedIn Description
A	Answered	MaaS Alliance	URL	Director of X	Specialized in X

Appendix III: Meeting request sent to experts via LinkedIn in Mail

LinkedIn inMail sent to Industry Experts (limitation to 300 characters)
Dear Mr(s). X, I hope you are doing well. I am writing my master dissertation on sustainable business models for MaaS and I am contacting you because I came across your role in this industry. Would you accept my invite so I can contact you regarding the topic in greater depth? Best, Sofia

Follow-up inMail sent to Industry Experts
Good afternoon, First of all, thank you for accepting my invitation. As I have already mentioned, I am writing my master dissertation on Mobility-as-a-Service, with the research question "How can a MaaS ecosystem create, deliver, and capture sustainable value?" Currently, I am conducting experts' interviews as your knowledge in the area is very important to conduct good research. Therefore, I would kindly like to ask whether you would have the time to schedule a 30min call. If possible, please let me know your availability. <u>Context</u> My theoretical foundation is built on the intersection of three topics: sustainability, MaaS, and business models. Further, I aim to explore the potential of MaaS to generate sustainable value and its implication within the value chain. All insights shared will be treated confidentially and the results of my work will be sent to you afterward. Some questions I would like to ask are: 1) What types of value does MaaS generate? And for whom? 2) Who are the key players in the value chain and what are their key activities? 3) What is each player's value within the ecosystem? 4) What factors affect value creation within the ecosystem? 5) Which types of value can be captured? And by whom? In case you do not have the availability to arrange a meeting, I would be extremely grateful if you could answer these questions in writing. Having your perspective on this would be extremely valuable. Thank you for your time and consideration, Sofia Rocha

Appendix IV: Industry experts' profile and background

	Data on Expert					Data on interview	
#	**Name**	**Job Title / Specialties**	**Organization**	**Background**	**Location**	**Length**	**Date**
1	A	Director	Nazza	Expertise in mobility	The Netherlands	45min	26/11
2	B	CEO	MExT Group	Ex member of MaaS Alliance	Belgium	50min	30/11
3	C	CEO and managing partner	Factual	Specialized in all mobility issues	Spain	42min	3/12
4	D	Director	EIT Urban Mobility Innovation	Expertise in urban mobility.	Spain	50min	3/12
5	E	Partner	EY	Works with Manufacturing and Mobility Companies	USA	37min	6/12
6	F	Senior Manager	Polis Network	Develops innovative technologies and policies for local transport	Belgium	60min	7/12
7	G	Director of mobility, automotive and cities	CEiiA	Designs, develops and operates innovative products in the mobility industries, namely Automotive and Urban Mobility	Portugal	46min	7/12
8	H	Mobility and Urban planning Consultant	Ubiquity Consulting	Works in the transport and mobility sector. Main client: transport authorities	Spain	59min	8/12
9	I	Independent expert	EIT Urban mobility	MaaS Alliance member	The Netherlands	60min	8/12
10	J	Chief Impact Officer	ITS Finland	Role in supporting the teams responsible for the Finnish National Growth Programme for the Transport Sector	Finland	66min	17/12
11	K	Senior Researcher (Former CEO and founder of UbiGo)	RISE	Expertise in mobility systems	Sweden	47min	20/12
12	L	CEO	Green Key Finland	Knowledge in sustainable development & circular economy	Finland	42min	21/12
13	M	Director	Strategeed Ltd	Works with a range of public and private organizations to think about innovation and strategic business needs	UK	54min	21/12
14	N	Future Business Technology Director	CEiiA	Designs, develops and operates innovative products in the mobility industries, namely Automotive and Urban Mobility	Portugal	68min	22/12
15	O	International sales director	Instant System	Publishes and markets MaaS solutions for public authorities and transport operators	France	60min	23/12

Appendix V: Industry experts summarized answers by categories

a) Value proposition

Sustainable value in mobility	- Better utilization of assets: a more effective situation of the underlying infrastructure, and a reduction of the number of vehicles that are necessary to provide the same or possibly even more transportation services; Services allow us to put vehicles to more effective usage and therefore reducing the total amount of vehicles at the same time providing just good service level for the end-user - Less impact on raw materials to create those vehicles - Public transport externalities (efficiency, equitability, reduced congestion and emissions) - Avoid and minimize the mistakes made in the past regarding mobility which resulted in waste, vehicles standing around being ineffective, requiring a great consumption of raw materials - Collective or combined mobility- increase the number of people that use a vehicle--> requires letting go of the concept ownership & tapping into the concept of ridership - If the objective is to have a more effective, more environmentally friendly transport system yes you need to have more people using PT and bicycles and all other modes except private cars, but those other modes of transport must include shared vehicles and others such as vehicles that offer the same comfort, space as private vehicles - Having the right device to make a certain type of journey - If we manage to offer mobility services that can replace a private car then you'll see many benefits: save a lot of space from parking, better accessibility which is the quality of life, easier everyday life - Meeting the needs of the planet, society, it isn't just about time or cost. Providing a range of robust choices in accordance to how people want to travel and what they value

Types of value generated by MaaS	**End-users**: are offered a better level of service which is affordable, flexible, convenient, customizable and personalized; healthier lifestyle; makes them feel good for contributing to the overall sustainability; the big advantage is to have integrated a whole set of means of travel, so the user has a single place with an integrated offer that gets as close as possible to the user (pays only what he uses).
	Society: Improved accessibility to opportunities and social inclusion, lower congestion, less noise, better air quality, more public space to citizens
	Environment: reduced emissions, reduced waste, increased green areas
	Transport operators: Increased revenue (new sales channels to reach more users; increase occupancy/increase the utilization of their resources). Experiment and collaboratively try to understand how to solve some of the problems; better marketing channels; it is a very interesting offer because it allows to differentiate from the rest of the market, only verticals (having an integrated PT offer with soft mobility allows a complementarity that a PT doesn't have, last mile can be done using soft mobility). Sustainability of PT will only have real impact when they are not fossil fuels - hydrogen, gas, electric are mixes that depend on the place. Risks: lose some of their customer control, lose some of the margins
	City/ local government: organizing mobility in a more coordinated way, attract more investment by making the city more attractive, achieve policy goals; possibility to charge higher prices, achieve the modal shift from private car towards other modes (although at the time there is no evidence that MaaS can help deliver this shift in mode); there is a rationalization of resources: mobility has several challenges (you have commuting peaks so you have to have the offer prepared to have these peaks but then 90% of the rest of the day is always very low - how do we play with this, this type of solutions allows a much nicer integration and articulation of resources
	Public authorities: ensure that the externalities of transportation are minimized; can be a very powerful tool to implement strategies that are in line with enabling more sustainable mobility
	App operator: new business opportunity
	Other service providers: new business opportunity as portfolio diversification (eg. for big companies like energy providers there is the possibility to increase customer relationship)

b) Customer segments

Customer segments	B2C	- Private car users - Younger generation (not only millennials but those who are used to services)
	B2B	- Corporations: Apply the travel agency concept but for local and regional business trips (buses, commuter trains); target commuting traffic - Government offering MaaS to public employees
	B2B2C	- Delivery companies (transport, last mile deliveries, supermarket distribution, etc.)
	P2P	- In neighborhoods

c) Value creation and delivery

Stakeholders	Responsibility and role
City/ local government	- Give incentives to go electric; give incentives for private operators to cover areas of less population density; increase gasoline price - Provide incentives to show the desired behavior through tax breaks and grants. i.e., increased tax benefits for cars that emit less carbon dioxide, grants for energy-saving solutions etc.
Public transport authorities	- Their role will shift from being at the top of the value chain to being part of the ecosystem with resellers of their service. Maybe experimenting with different price models, etc - In charge of ensuring that mobilities are sustainable and equitable as possible - Strong role in governing the ecosystem and in steering the deployment of MaaS locally by enabling a modern and digital PT offering and takes care of all the data that the platform generates to better manage mobility - Are at the center because they're pooling a whole series of infrastructure based on how people want to live in their cities, attaining public objectives and trading a whole serious of issues (i.e., give the right infrastructure: more micro mobility space and less road space). The only one who has the ability and probably the right to start making those trade-offs in society - Define requirements to operate in a city (i.e., condition to operate in suburban areas), push cooperation between modes, intervene where they see market distortions, or when they see that its leading to less sustainable outcomes
Suppliers	- Key role in delivering sustainability objectives (i.e., by recirculating)
OEMs	- Can either take the role of MaaS industrial companies producing the assets or adapt to be service providers - They must go through the whole transformation to EVs which simplifies the industrial footprint of what they are currently producing
Public transport operator	- Digitalize/update; - PT must be a fundamental piece to move the masses and make people stop using cars - Backbone of the service
Private transport operator	- Have the responsibility to the city and respect to the citizens that their devices are put in a good place; - There is another piece, soft mobility, in which when you combine this with PT only then you decarbonize the area of mobility for people
Platform operator	- Create platforms to integrate and connect existing transport operators to service providers - Take care of the commercial agreements, technical connections, billing, etc - Offer the best option to the customer by provide the most sustainable mode of transportation that matches the needs of end-users - Take the interests of every part involved in the ecosystem
IT companies (i.e., google, apple)	- In any mobility debate, they have a core role to play because for many people they'll still be the default solution, and they have the funding and desire to influence a lot of what's going on in mobility
The banking industry (master card, visa)	- Payment providers have an increasing, powerful ability and way to make transport more seamless and easier to implement - They link together transport in a much more innovative way rather than just being a payment provider and probably there are regulatory issues
Employers	- A group we regularly forget. People usually move to and from work, so the employer is big part of the solution. If you don't embark the employer in the equation of mobility you are going to miss something and you are going to fail - Have a key role in targeting commuting traffic

Data	
Requirements	- Create rules on how to share the data - Open data architectures to have the data and then use this data in the analysis for further decisions - The data is very valuable, as valuable as the companies or entities are willing to pay for it and when they know what to do with it - Its value will depend on the act and skill of who has it and how they work it and what insights they can get from it because we talk a lot about data (eg. face, google) but they have data, and then on top of that data that is analyzed, they extract info, and on top of that info they create insights (whole chain) the question is if municipalities have the capacity to have this chain, - Having just the data is worth what it is worth, if you don't know what to do with it, it is useless: the question is what do municipalities do with that? - The most important party is not a question of who is giving the technology, the most important question is: the technology that is going to be deployed, who owns the data?
Benefits	- Info and data is very important and sometimes it not being exchanged very well because operators don't feel they need to at this point in their business cycle - Services improve all the time because you get data from the services and based on that data you can upgrade your service (i.e., adjust your pricing model) and all these things help stakeholders to create better, more effective, cost-effective, environmentally friendly services that are constantly developing and therefore upgrading themselves all the time and therefore getting better than the private-owned cars from which they are getting the money - To optimize the operation of a private or public each of them needs the info of each other (i.e., you have an accident, the bus is going to be late, operators need the info to see what kind of solution they can provide - The biggest value is in the power of data analytics - Data is very important because with data you can have some knowledge to improve - If operators share all the data, they'll be able to know their customer
Problems	- The local authorities don't have a way of systematically collecting the data from the operator in a structured, meaningful way. - There is no standardization

Platform operator		
Public company	Favor	- The transport authority has the power in hands to choose which operator is going to work in your city - Can be good for the end-users, and for some of the companies who join this ecosystem - PTA or public entity could make sense when we talk about the intermodal trip (A to B) especially if they can integrate the tariffs which would be complicated
	Against	- Not their strength as it is a digital economy - Huge number of risks associated with this kind of operations because we are in a completely new area of business, and it's completely funded by task payers and its quite hard to justify using taxpayer money on something that could be done by private companies who also take care of the risks - Authorities are endless pockets: you can always take more and more money from the taxpayers but that leads to a process where there is no evolution - Public actors are very bad at being agile, trying business, making creative contracts with suppliers and so on, that is not really their role
Private company	Favor	- A private company has to evolve all the time because otherwise someone else will take your role and offer better service to end-customers - When private service providers start joining a public Maas platform there might be problems that could be avoided if private companies operate and run the MaaS platform - It should be someone who can concentrate on the customers and developing a business that attracts customers. then its up to the region, city to set the boundaries so that the service is sustainable - Have the necessary IT capabilities - The biggest reseller of PT tickets in Antwerp is the bank because the bank integrated ticketing into their regular banking app, without profit but to make their customers more loyal
	Against	- We wouldn't have a good chance for systems if we would just allow private companies take place and we can see what's happening in the USA, market influence, the cities don't work because there is not efficient public transport, and everything must be written under the rules of private cars and that leads to terrible costs associated with environmental problems - The private is probably going to only serve the ppl who can pay for the service

d) Value capture

Stakeholders	Value capture
Cities/ local government	- Save a lot of space especially regarding parking and you can free that space for other uses/purposes than parking cars and that's valuable in cities: redistributing land with services that take away private cars (building new apartments, many options) - Return on investment by making cities more attractive and therefore attracting foreign investment and fostering economic development - In the long-run, positive impact on the health ministry budget (government can capture the money they invest): By allocating money to infrastructures that support services, in the long-run it will have a positive impact for citizens' health which translates into less people needing assistance and therefore value is captured through less costs for the health administration. Problem: silos
End-user	- Quantify co2 reduction, turn It into credits to be able to make transactions with that (e.g. earn money by emitting less GHG, buy green products) - Saving money and time
Environment	- Improved energy efficiency - Reducing use of non-renewable resources - Reducing emissions associate with burning fossil fuels
Business	- Reduced costs by optimizing use of materials - Increased revenue by an increase of market share - Increased customer loyalty

Revenue streams	
Subscription	- subscription is beneficial in terms of the service provider knowing who customer really are, their behavior, credentials, etc so he can monetize on this + other parties can trust this service provider that he will only deliver customers who are trustworthy - Subscription enables to bundle depending on the usage and the target group (all you can eat because I use transportation all the time vs bundle of x km p/month) - Working with price models that can attract other customers so they create value for the suppliers but also for the consumers. Customers will never compare the prices on single trips. they don't really care if its a good deal because the operator managed to make the best deal - Better distribution model by creating new value
Pay-as-you-go	- Pay-per-use will incentivize more the change of behavior (e.g. 1km in PT could be cheaper than 1km in ride-sharing vehicle; if a customer shares a ride with other people for a part of a trip they can increase the number of people per vehicle and as a result the customer pays less for its trip, the operators gains two paying customers, as a city there are fewer vehicles on the road
Both	- Both pay-as-you-go and subscription have the potential to create sustainable value, they go for completely different target groups (subscription is for regular users, pay-per-use for occasional users)