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Master Thesis

Moped sharing building sustainable cities: defining critical success factors that enable operators to develop efficient business strategies

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Abstract

The study identifies and analyses the most influential external and internal factors that affect the outcome of moped sharing businesses. These are defined by first reviewing existing literature and then carrying out semi-structured interviews with experts in the industry. The research first displays the most influential factors and then highlights the most important ones by the degree of influence these have on the business. On that base, a conceptual model is developed which displays the interrelation of these influential factors within the industry ecosystem, including the legal, climatic, infrastructural, and operational dimensions. The factors determine the outcome of the business by affecting the degree of user adoption and retention, and operational cost reduction. These two outcomes, in the end, determine if a moped sharing business can be economically sustainable. A profitable moped sharing business can then develop a sustainable service by reinvesting in its internal factors to improve their business practices and scale its model. This outcome can be translated into an effective mobility service that brings value to society by contributing to economic wealth, social welfare and environmental sustainability. Finally, on the academic side, the study addresses a gap that exists in the category of moped sharing modality, therefore the research helps enlarge the corpus of knowledge in the shared mobility topic.

Keywords: shared mobility, moped sharing, critical success factors, sustainability, urbanism, smart city, business development

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1. Introduction

The 21st century is characterised by increasing awareness on problems related to social and environmental issues. In the context of cities, urban planning is falling behind within these matters at the face of an ever-growing urban population and the decreasing quality of life for its citizens (Machado et al., 2018). The World Bank (2018) estimates that by 2050 cities will attract around 5.4 billion people (roughly 66% of the global population), boosting the number of vehicles on the road to an estimate of 2 billion units. This rapid growth is manifested in more traffic, reduced space for parking, deterioration of the air quality, and public transportation not being able to expand fast enough to serve the newly developed areas (Machado et al., 2018). These problems render urban mobility as one of the most relevant issues that cities nowadays are struggling to cope with, and occupy a relevant place in the political agenda.

The advent of the sharing economy as the new paradigm of consumption in this century has been replacing traditional businesses as we know them by replacing the notion of 'owning' for 'renting' (Böckmann, 2013). Böckmann (2013) adds that sharing services can be seen as a solution to the overconsumption of this era, which are also linked to the growing awareness of the environmental issues the world is facing. Therefore, the mentality of society regarding consumption is shifting to renting on-demand services instead of opting for ownership. This phenomenon has deeply impacted the mobility business and has fuelled the popularity of shared mobility, which has been flourishing in markets within the USA, Europe, China, as well as in Southeast Asia and India (Car Sharing Association, 2019). Within the sharing economy, the segment of shared mobility has the greatest potential to disrupt the transportation systems and provide alternative solutions to the mentioned challenges. These issues, added to the tedious processes of hiring traditional rental vehicles are causing commuters to change their behaviour and turn towards innovative technologies that ease those pain points (Shaheen, Cohen, & Zohdy, 2016).

Shared mobility connects supply and demand of available vehicles through mobile technology for pay-as-you-go rental service. The rapid proliferation of these services across the world has laid the path for new businesses to offer new shared mobility services in untapped markets. Within the vast variety of available modalities, moped sharing is a relatively new service that has been running since 2012 and rapidly gaining considerable market share. It is pertinent to mention that although in literature the terms *moped* and *scooter* are usually confused, in the context of this research, the object of study will be referred as *mopeds (Vespa style)* while the term *kick scooters* will refer to the more popular low-speed vehicles in which riders need to stand while driving.

The demand and supply of the moped sharing market have more than doubled between 2018 and 2019 and this spike in popularity is not expected to slow down (Howe, 2019). The little space mopeds require, the agility they provide in traffic, and the predominance of electric fleets (which contribute to environmental sustainability) render mopeds as an ideal solution for the mentioned problems cities are facing due to growing population. Given its rising importance, many local players are starting to roll out their own fleets in cities around the world, and international players are expanding their successful models to new markets. However, the shared mobility business operates in a dynamic environment, where each city provides a unique scenario that involves different internal and external factors that can influence the outcome of the business in different degrees.

The goal of this study is to develop a model that can help moped sharing companies understand and assess the different factors that influence the competitive performance of the business. By carrying out a comprehensive analysis of the most influential factors, their interrelations, and their impact on the industry ecosystem, a conceptual model is proposed. With this conceptual model, new entrants can have a better overview of which elements need to be considered in the business strategy to achieve competitive advantage. Moped sharing operators can then anticipate any environmental contingencies and focus their efforts on areas of the business that create most value, which ultimately translates into higher performance. The identified critical success factors in this research are fleet and business management, norms and regulations, operational efficiency, weather, cooperation with authorities, city layout, and public transportation availability.

On a secondary level, this research is also useful for authorities to understand the rules of the game when opening a space for dialogue and cooperation, and to understand how certain norms or legal restraints can have an impact on the services. Moreover, the academic research on this sector at the time of concluding this research is limited, and there are no systematic studies to define a benchmark to assess the viability of a city for moped sharing businesses. The challenge of introducing shared mobility services in new markets is not only bounded to economic factors but also social, technological, cultural, political, infrastructural (Wiprächtiger, Narayanamurthy, Moser, & Sengupta, 2019), as well as climatic.

Machado et al. (2018), insist that the need to efficiently integrate new mobility solutions is imperative to guarantee a sustainable future within urban environments. Therefore, providing a conceptual model that can help the development of moped sharing businesses globally will be relevant for achieving not only social welfare in the sense of improving cities lifestyle, but also contribute to

environmental sustainability. Having a clear overview of the topic of research and the gaps that can be cover in this research, the master thesis can be summarised with the following research question:

Which are the most important factors that need to be addressed by moped sharing operators to ensure a sustainable competitive performance in a new industry ecosystem?

2. Theoretical background

In this section, the most important concepts upon which the research is built are explained. In the first section, the definitions of shared mobility and moped sharing are enounced. Next, literature related to critical success factors and the processes involved in their identification and prioritisation are presented. Lastly, a review is made on the existing literature that covers the different factors that influence the outcome of moped sharing services.

2.1. Shared mobility and moped sharing

According to Machado et al. (2018), shared mobility can be defined as an alternative transportation method that intends to increase the utilisation of the available mobility resources and aims to disconnect people from vehicle ownership. The authors add that the term *shared mobility* refers to the shared use of services and vehicles for short-term access (Machado, Hue, Berssaneti, & Quintanilha, 2018). Santos (2018) adds that the use of technology enables access to vehicles on-demand and connect users and providers. This provides an alternative to reduce the need for a private vehicle to move around. Shared mobility can then be defined as *an alternative transportation modality that, with the use of mobile technology, enables people to rent vehicles available on-demand for a short period.* To start talking about shared mobility it is necessary to clarify the difference between the terms *shared mobility* and *MaaS* (Mobility as a service). The latter serves as a centralised platform for commuters to have their available travel options tailored to their individual needs, either as a subscription package or a service like pay-per-use, by an integrated mobility provider (Becker, Balac, Ciari, & Axhausen, 2019).

Shared mobility has a considerable disruptive potential over traditional transportation systems and the importance of its development lies in the fact that according to the World Bank[1], by 2050 around

[1] World Bank. Transport Overview. 2017. Available online: http://www.worldbank.org/en/topic/transport/ overview (accessed on 19 November 2018).

two-thirds of the global population (around 5.4 billion people) will live in cities, and the number of vehicles on the streets will double, reaching 2 billion vehicles on the road (Machado et al., 2018). The authors say that this projection will have consequences on increasing traffic jams, decreasing quality of the environment in urban areas, and difficulties enabling public transport to reach new developing suburban areas. The transportation sector represents one of the main problems in the agenda of public policy nowadays, especially regarding the problems just mentioned, and the economic, social and environmental repercussions that these convey (Machado et al., 2018). Shaheen et al. (2016) argue that the emergence of shared mobility enhances access to transportation, increases multimodality, discourages vehicle ownership, reduces vehicle miles travelled, and in some cases brings goods and service closer by providing new ways to access them. Due to the new social mindset towards ownership, to demographic and cultural shifts and advances on information and communication technologies (ICT), shared mobility is proliferating around the world at a rapid pace (Machado et al. 2018). Because of this, there is an increasing need to understand the how to integrate shared mobility into the different transportation systems from different cities and optimise it from a social, environmental and economic point of view (Machado et al., 2018). The authors argue that up to recently, shared mobility has been taken as an isolated system and the complex ecosystem that this new type of transportation implies has been neglected.

These kinds of alternatives to ownership of vehicles can help reduce not only traffic congestion but also CO2 emissions (Santos, 2018). According to Aguilera-García, Gomez, & Sobrino (2019), the fact that 97% of the shared mopeds on the road are electric (excluding India), not only contributes to a cleaner environment by reducing carbon emissions but also traffic congestions are minimised. However, the author adds that the extent of these reductions depends also on other factors like how many people are commuting in the same vehicle for example. If it is only a driver, or a driver and a passenger, transport on-demand will have better performance in terms of sustainability. Finally, fleets that have electric motors contribute to a reduction in noise pollution since electric vehicles are considerably quieter than traditional combustion engines (Phillips, 2019; Santos, 2018).

The modalities that compose the shared mobility landscape are car sharing, bike (and e-bike) sharing, kick scooter sharing, moped sharing, and ride sharing (carpooling and vanpooling) and all these services have emerged in the last years (Shaheen, Cohen & Zohdy, 2016). The authors add that most of the services are being offered either in unattended stations or free-floating, thanks to the advances on ICT which facilitate the transactions for rentals of vehicles in an automated way. Normally, the operators are responsible for the management of the fleet, including parking according to regulations, refuelling, maintenance, and redistribution (Shaheen et al., 2016). To use these services, users rent

out a vehicle from their smartphone from the operators' fleet which is spread across the operational area. To do this, the users locate an available vehicle through the app, rent it out, ride it, and finally park it within the business area, and finish the rental with the same app. The payment is debited automatically from the selected payment method or pre-paid credit that the user might have in the account. This way of delivering the service is standardised nowadays among different modalities of transportation and companies. Although the type of shared mobility services that are in the spotlight are car sharing, bike sharing and scooter sharing, moped sharing is gaining rapid popularity in many regions around the world. Since its beginning in 2012, the moped sharing market has been steadily growing and in the last year with the inclusion of India as one of the most promising sectors in the market, the numbers grew exponentially (Jakobsen & Howe, 2019). A detailed market overview is available in the appendix.

2.2. Critical success factors identification

Critical success factors (CSF) can be defined as "areas in which results if they are satisfactory, will ensure successful competitive performance for the organisation" (Rockart, 1979). Saraph, Benson & Schroeder (1989) describe CSF as those key areas of managerial strategy and execution that needs to be practised to achieve effectiveness. Boynton & Zmud (1984) complete this definition by pointing out that CSFs can be used to steer the efforts of an organisation into developing strategic plans that can help managers and companies to achieve high performance and identify potential critical issues associated to the implementation of the mentioned strategic plan. Belassi & Tukel (1996) also add that CSF can also include factors that are outside the control of the managers of a company and that can determine the success or failure of a venture or project. Taking the different definitions provided by the different authors, we can then conclude that CSF are *important areas that need to be considered in the strategy of a business, for their effective management can improve the performance of the organisation and provide a competitive advantage within the industry.*

The concept of CSF has three levels of analysis in its application: firm-specific, industry and economic/socio-political dimensions (Leidecker & Bruno, 1984). Each dimension contributes a different set of potential CSF: firm-level is focused on the internal processes of a company; industry level focuses the factors of the industry that can have a significant impact on the company's performance; finally, the third level of analysis related to the environment, where according to the framework proposed by Belassi & Tukel (1996), includes the analysis of external factors such as

political, economic, social, and technological environment, nature, client, competitors, and sub-contractors.

Identification and prioritisation of CSF

Leidecker & Bruno (1984) propose some techniques to identify and prioritise CSF. For the purpose and focus of this study, the *environmental analysis and industry/business experts* ones are taken into consideration. The environmental analysis has different approaches that are used to identify the economic, political, and social forces that have a significant effect on a firm's performance (Leidecker & Bruno, 1984). This is important when analysing businesses that depend on external environmental factors, especially when it comes to services like moped sharing which need to operate in open public space. In this study, the PESTLE analysis will be adopted to define the environmental factors. The classic "PEST" analysis is used to understand strategic risks by identifying any changes and effects of the external environment at a macro level on the competitive position of a firm (Sammut-Bonnici & Galea, 2015). The authors also present another variation that includes the Environment and Legal factors (PESTLE). As the firms operate within a larger ecosystem, they are vulnerable to several external factors, which in the end can have a dramatic impact on the firm's competitiveness. The influence and potential risk of these exogenous factors can be diminished by implementing pre-emptive strategies, and new opportunities can also be discovered and exploited in the process, something that leads to new competitive advantages (Sammut-Bonnici & Galea, 2015). The *industry/business experts* resource, according to Leidecker & Bruno (1984), relies on the inputs from people working in the industry, who have vast knowledge and experience in it. This is an excellent source for collecting CSF through a qualitative data collection approach. The authors, however, warn that the opinions collected can be biased to some extent. It is important in this case to keep the focus and ask the 'right' questions, address the 'right' sources and conclude with the 'right' interpretations. The advantage of conducting such an analysis is that understanding the elements or processes that make a firm successful can help on more general analysis and strategic understanding of what the critical success factors are.

To establish a prioritisation system for CSF, Leidecker & Bruno (1984) propose a scheme which is built on 4 blocks to evaluate the relative impact that these can have on a firm. The first block is *major activity of business* and suggests that CSF can be found in the most important areas of a firm. For example, a wholesaler would find most of the CSF in and around the warehousing and inventory. The second block, *large dollars involved,* indicates *that* CSF, in this case, can be found where large costs are. If direct labour is a large dollar amount, CSF could be found in the productivity of the workforce for example. The third block, *major profit impact*, considers that the overall results derived from

changes in certain activities can be an indicator of CSF. For example, in some cases, a small change in price might have a huge effect on bottom-line whereas raising the advertisement budget could not have the same effect. Finally, the fourth block, *major changes in performance,* determine that CSF can be also looked in considerable changes in the firm's performance. For example, significant increases in margins or a dramatic drop in sales can be linked to a major CSF.

2.3. Critical success factors in shared mobility

Most of the existing literature focuses on car sharing, bike sharing, and e-scooter sharing. Because there is less research published on shared moped services little can be found about the CSF for this particular sector of the shared mobility ecosystem. For that reason, when constructing a pre-conceptual framework, different factors were aggregated from existing literature which is related not only to moped sharing services but also to other modalities. These factors were finally consolidated into a list and considered when they were mentioned either explicitly or implicitly in the literature.

The literature review comprised a total of 9 sources, and the initial approach was to diverge when aggregating these factors. The initial list was extensive and was further filtered and reduced as the research developed since the grounded theory approach allows the analysis of the data to be performed simultaneously as the data is collected (Flick, 2009). From a total of 37 factors that were initially compiled, a list of 15 CSF was finally consolidated as a precedent theoretical framework. All of these factors were clustered on an environmental level of analysis (referring to the CSF identification framework by Leidecker & Bruno, (1984)). Table 1 then shows the result of the first iterative cycles on the literature review with a total of 19 factors arranged in 8 different categories.

It is pertinent to highlight the fact that not all literature was focused on moped sharing. Some factors were borrowed from literature that was studying other modalities such as bike sharing and car sharing. However, these factors could be logically related to the moped sharing case, either by being directly applicable or by association. An example of the latter can be the fact that hilly terrains can be discouraging for bike sharing, however, this could mean that moped sharing has an advantage as it has an electric motor to do the work. The articles that were most relevant in the initial findings (which accounted for the 37 factors) were the ones published by Murr & Phillips (2016), Médard de Chardon et al. (2017), Krümmel et al. (2019), and Krümmel et al. (2019). Table 1 shows the previously mentioned list that was initially processed to build the theoretical background.

Category	Factor		Source
Demographic factors	*Population*	Size of the population and density, average age, average household size, gender, and educational level	*Murr & Phillips (2016); Kortum et al. (2016); Médard de Chardon et al. (2017); Machado, Hue & Berssaneti (2018)*
Cultural factors	*Awareness*	Adoption of micro-mobility vehicles such as mopeds, as well as previous knowledge of shared mobility services, and social media interaction	*Murr & Phillips (2016); Médard de Chardon et al. (2017), Howe (2016)*
	Driving culture/Vehicle ownership	The preference of people towards owning a personal vehicle	*Murr & Phillips (2016); Médard de Chardon et al. (2017)*
	Vandalism	Inappropriate use or damage of shared mobility vehicles	*Axsen & Sovacool (2019)*
Infrastructural factors	*Traffic*	The level of traffic in a certain city, translated in average commuting time	*Médard de Chardon et al. (2017)*
	Available public transport and daily usage	Available public transport types, number of services they offer and the daily usage	*Murr & Phillips (2016)*
	City layout	Wideness of streets, sidewalk configuration, parking spaces and existence of bicycle lanes, as well as steepness of terrain, and characteristics of the roads (materials and condition)	*Murr & Phillips (2016); Krümmel et al. (2019); Médard de Chardon et al. (2017), Machado, Hue & Berssaneti (2018)*
	Public transport system integration	Bike parking at rail stations and bus stops, bike routes that lead to public transit stations, and transit car integration to shared mobility alternatives	*Médard de Chardon et al. (2017)*
Climate factors	*Weather*	Average temperature and its variation between seasons, as well as the amount of snow, wind, rains, and sunshine.	*Murr & Phillips (2016); Médard de Chardon et al. (2017); Machado, Hue & Berssaneti (2018)*
	Air pollution	The quality of the air and environmental impact	*Machado, Hue & Berssaneti (2018)*
Market factors	*Competitors*	Existing shared mobility providers, who are they, how long have they been in operation in the city, what kind of service they offer	*Murr & Phillips (2016); Médard de Chardon et al. (2017)*
	Existing customers	Number of people already using shared mobility services	*Murr & Phillips (2016); Médard de Chardon et al. (2017)*
Legal factors	*Support from authorities*	Openness and support from authorities towards shared mobility initiatives, i.e. sustainability goals, flexibility on regulations, partnerships, funding, incentives, etc/.	*Murr & Phillips (2016); Médard de Chardon et al. (2017); Krümmel et al. (2019); Shaheen & Cohen (2018)*
	Norms and regulations	Existing rules for driving the vehicles, driving licence requirement, speed limits, vehicle compliance. parking regulations, and fleet number restrictions. It is also related to taxation, insurance and regulations related to data management.	*Médard de Chardon et al. (2017); Krümmel et al. (2019); Shaheen & Cohen (2018)*
Economic factors	*Local market availability*	Availability of locally produced of vehicles, and barriers for importing vehicles and parts	*Krümmel et al. (2019)*
Operational factors	*Fleet management*	The operational management of the fleet involving procurement, rebalancing, storage, maintenance, charging, cleaning, and disposal of the vehicles	*Krümmel et al. (2019); Deloitte (2016)*
	Technology and UX	The interaction with the user regarding the service: locating mopeds, locking/unlocking, paying and customer service	*Krümmel et al. (2019)*
	Communication and customer service	Communicating with the customers and providing assistance and support through clear information, and access to hotlines	*Krümmel et al. (2019)*
	Operational efficiency	Orchestrating the operational processes to achieve a better efficiency on the assets, meaning more efficient service, higher utilisation rates and reduced operational costs.	*Deloitte (2016)*

Table 1. Pre-conceived list of factors based on literature review

3. Methodology

This study includes a literature review and establishes a strategy for validating the formulated theoretical constructs to be able to identify which are the critical success factors characteristic of the moped sharing industry and their interrelation in the industry's ecosystem. Since the nature of this research is to explore undefined concepts, a qualitative study was undertaken to investigate and validate the CSF for moped sharing. Moreover, Zikmund, Babin, Carr & Griffin (2009) explain that exploratory research within a business environment is usually conducted to determine situations that are ambiguous or to discover potential business opportunities. Since the purpose is to develop a theory, the grounded theory approach is used (Flick, 2009). This method presents a degree of flexibility when it comes to its guidelines, starting with an open and explanatory procedure which progressively leads to building up a grounded theory based on actual data. It is a research method that includes qualitative and inductive research and studies individual concepts to find different patterns that lead to the development of concepts (Glaser, Strauss & Strutzel, 1967). According to Flick (2009), collection and data analysis are performed simultaneously. To define a theoretical model for the CSF on moped sharing, the study first includes the initial findings and concepts that were identified in the literature and later validated and expanded with the data collected from the expert interviews. After that, new concepts that weren't previously identified in the theoretical background are induced, and the resulting list factors is redefined through a cyclic process of filtering and clustering. In the end, the factors are assessed by their degree of importance, and a final conceptual model is presented with the final list of factors, its interrelations and implications to all stakeholders involved.

3.1. Literature review

The literature review selection process was based on the method proposed by Wolfswinkel, Furtmueller, & Wilderom (2013). This model developed can be seen in appendix section 7.1. The search engines used to search for academic literature were Google Scholar and Scopus, and in some cases, standard Google searches were performed. An array of keywords was used, both the terms on its own and in combination with each other to narrow down the results. These can be referred to in table 5. The selection criteria also followed Wolfswinkel et al. (2013) approach: after filtering out doubles, the resulting papers were analysed and discriminated by reading their abstract. This process carves out the most relevant material which then goes through a more rigorous selection based on the full text. The last step consisted of looking at forward and backward citations, using the main articles in the literature review. This ongoing search activity did shape however the literature review strategy. By going through several academic papers, new sources provided further terms and

definitions that set ground to re-define certain approaches, and in some cases, rethink some core concepts of the research. Wolfswinkel et al. (2013) add on to this process by stating that it is expected to find academic sources that will make the researcher revisit previous set sampling and related criteria.

The resulting streams of knowledge were organised into three sections. The first section explores the theory of critical success factors identification. The studies from Rockart (1979), Boynton & Zmud (1984), and Belassi & Tukel (1996) were referred to, but the main paper used as an anchor for the CSF identification and prioritisation was written by Leidecker & Bruno (1984), which presents a holistic analysis of the topic. For the development of the theoretical background, the environmental analysis proposed by the authors was taken as a reference point given the initial approach was to analyse the industry ecosystem and the external factors that affect it. The second section focuses on general definitions of shared mobility and later refers more specifically to shared moped services. The purpose is to define the role it plays in the shared mobility ecosystem and converge the topic into a more detailed explanation of how the moped sharing service works. An updated market overview is also included in the annexe to further justify the importance of researching into this still incipient shared mobility modality. The most valuable information in this section was retrieved mainly from the work of Shaheen, Cohen, & Zohdy (2016), Shaheen et al. (2015), Machado et al. (2018), and Howe & Jakobsen (2018), among others. Finally, a pre-conceived list of factors was constructed, based on selected academic papers that explore key success factors not only for moped sharing but also for other types of shared mobility services, namely, car sharing, bike sharing and kick-scooter sharing. The reason of analysing other shared micro-mobility services is that there isn't much literature available on moped sharing, so borrowing concepts from similar services helped elaborate the list of factors that would further be validated with collected data. The main factors for the list were found in different research papers from Murr & Phillips (2016), Kortum, Schönduwe, Stolte, & Bock (2016), Médard de Chardon, Caruso, & Thomas (2017), Krümmel, Gernant, Stolt, Benedikt, & Moschner (2019), and Axsen & Sovacool (2019). The aggregation of these factors was also tagged with a preliminary weighting score, based on the times each factor was mentioned in the literature. The resulting table of CSF served as a starting point to subsequently develop and conduct semi-structured interviews with experts in the moped sharing industry.

The search strategy used for this topic was somewhat challenging. The main problem that was encountered when defining the search strings was that the term "scooter" is both used for the kick-scooters and the "Vespa" type of electric vehicle, being the latter the object of research in this study. When trying to find information specifically related to mopeds, the words "scooter" or "electric

scooter" had to be used. Naturally, the majority of the queries returned results on articles that referred to kick-scooter sharing, which is considerably more popular than moped sharing at the time of writing this research. Nevertheless, over many reiterations, a few informative reports by Krümmel et al. (2019), Howe (2018), and Howe & Jakobsen (2019) were found and used. These were combined with other articles on key success factors for bike sharing, car sharing and kick-scooter sharing. The list of academic sources used to build the pre-conceptual list of key factors can be seen in the appendix on table 6. As mentioned before, the main search engines used to search for academic sources were Google Scholar, Scopus, and regular Google searches. The database manager used to keep the articles organised was Mendeley. Most relevant search strings can be found in the appendix on table 5.

3.2. Level and unit of analysis

When conducting a research on CSF, it would not serve the purpose of this study to include all the elements of the strategy formulation process by Leidecker & Bruno (1984), so the level of analysis is focused on an industry level, regarding the framework proposed by the authors. The reason is that the study aims to identify patterns in similarities and differences across geographical regions, which contemplate all players in the market from the same external perspective. Because of this, the scope of this research is strictly constrained to an industry-level analysis, leaving aside -perhaps for further research- the firm-centric analysis of the CSF.

Shared mobility includes a broad range of services that adapt to the diverse needs of the users. Machado et al. (2018) classify these as *car sharing, personal vehicle sharing, bike sharing, ridesharing and on-demand ride services.* Figure 1 shows a modified version of the original hierarchy graphic proposed by Machado et al. (2018). The modification includes a new category created for shared micro-mobility services, to represent a better picture of what is available in the market nowadays. Bike sharing, e-scooter sharing, e-bike sharing, and moped sharing are then clustered under the "micro-mobility" category. Two reasons exist behind the decision of creating this new category and clustering the four types of micro-mobility services. The first one has to do with the weight of the vehicles. For a vehicle to be considered as "micro-mobility", they need to weigh less than 500kg (Dediu, 2019). The second reason is that this category refers to personal vehicles that can carry a maximum of two passengers[2]. Additionally, a car needs to find a spot on the street, whereas up-to-date a bicycle, e-scooter, or moped can be parked on the sidewalk (provided that it is not blocking the pedestrian's way) or depending on the regulations, in designated parking spaces designed specifically

[2]Witzel, S. (2018). How Micro Mobility Solves Multiple Problems in Congested Cities. Retrieved from https://skedgo.com/how-micro-mobility-solves-multiple-problems-in-congested-cities/

for micro-mobility vehicles. The unit of analysis in this study will be limited to the analysis of moped sharing services. The category is highlighted in red colour in Figure 1, to better clarify the scope of analysis.

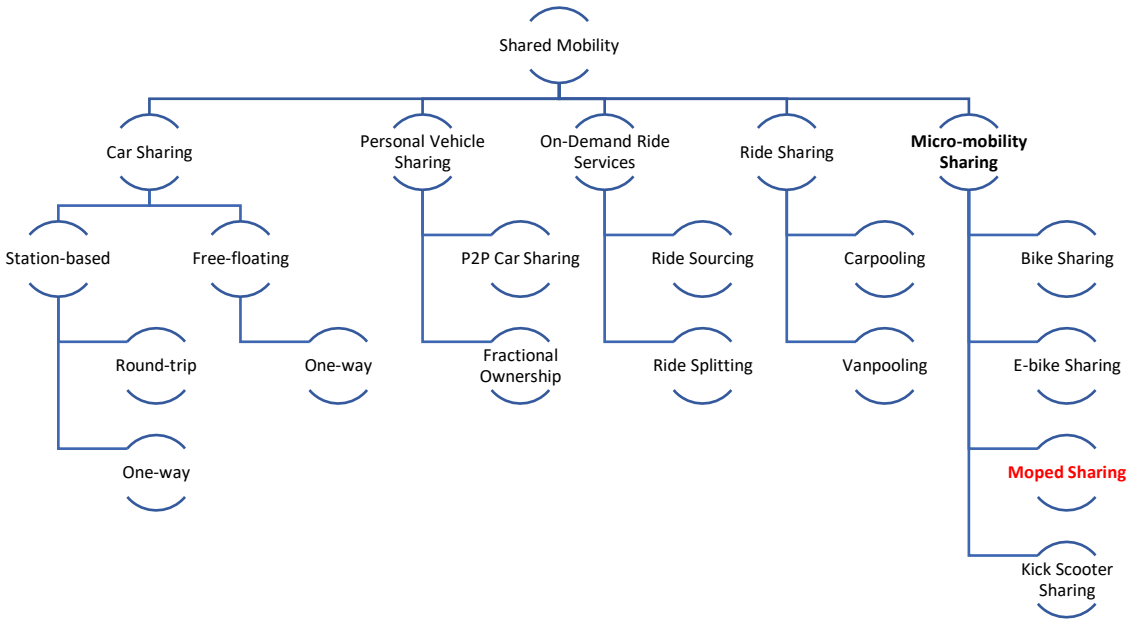

Figure 1. Moped sharing within the shared mobility ecosystem. Source: Modified version from Machado et al. (2018)

To justify the object of analysis focused on moped sharing, it is pertinent to mention that different micro-mobility vehicles present different characteristics and are suitable for different commuting situations. The mainstream vehicles for micro-mobility used today in cities around the world are bicycles, electric bicycles, kick scooters, and mopeds. Another variant of electric bicycles is the s-pedelecs, which are a category of e-bikes that include a more potent electric motor that allows riders to go at faster speeds. However, since no shared mobility operators offering this kind of vehicle could be found, it wasn't taken into consideration. The differences between these vehicles are speed, weight, typical distance travelled, the life cycle of the vehicle, type of propulsion, and power of the electric motor (if it has so). These different characteristics make the sharing service be affected by CSF in different ways, hence a certain level of focus was necessary to be more precise on the nature of this influence.

3.3. Data collection from interviews to industry experts

Based on the theoretical background conceived in the literature review section, the next step was to design the semi-structured interviews for data collection. Alsaawi (2014) explains that semi-structured interviews allow the researcher to control the direction of the interview by asking pre-defined open-ended questions. In these types of interviews, the idea is to start by addressing a list of topics and questions that need to be covered and which can vary depending on the context of the interview (Saunders, Lewis, & Thornhill, 2016). For example, some questions might be omitted when they are not relevant or can be sensitive in certain organisational contexts. As the semi-structured interviews are non-standardised, even the order of the questions can be altered, depending on the flow of the conversation (Saunders et al., 2016). The authors also explain that the collection of data from these interviews can be done by recording the audio of the conversation or by taking notes. To preserve ethics and privacy of the participants, they are asked a priori for their contentment to record the conversation. The recording is explicitly intended for transcription purposes, to avoid missing any important information that the participant might provide. The audio files were subsequently uploaded to a speech-to-text recognition software called Otter, which transcribed and saved each interview on a cloud account. Finally, each interview was reviewed and pertinent corrections (due to misinterpretation by software) were made.

Before starting with the round of interviews, a guide was created which can be referred to in section 7.4 of the appendix. The questions were elaborated based on the theoretical framework that was created during the literature review. The invitations were then sent to professionals in the shared mobility sector, who were related to companies that offer moped sharing services, and within this context, the targets were leaders or referents of the industry and researchers that have contributed to the industry in a significant way. Although there was a standardised set of questions that were common to all interviewees, each interview was partly tailored depending on the person, their position and their expertise. This means that with some interviewees, more or less emphasis was made on the topics that were discussed, according to their knowledge and/or experience. But most importantly, the nature of the semi-structured interview allowed a certain degree of flexibility that facilitated rapport. This way a more fluid communication was achieved, which ultimately lead to a better quality of the information provided.

The geographical target when creating the strategy to send the invitations was not confined to a certain region, as I considered that insights from different parts of the world would provide a broader scope of observation, especially when inquiring about cultural factors. A wider geographical approach

provided valuable information from different markets that led to the discovery of specific patterns. These patterns were valuable when validating and expanding the pre-conceived key success factor framework. Maltreud et al. (2016) state that the size of the sample when evaluating how many people are supposed to be interviewed should be large enough and varied, to consolidate the study. Fusch & Ness (2015) argue that a researcher reaches data saturation when enough information is obtained to replicate the study and when it is not possible to obtain new information, hence, further coding is no longer possible. In the case of this research, eleven interviews proved to be enough intake of information to construct a valid argument. The decision to stop at this number was that information provided by experts from completely different geographical and cultural backgrounds was already overlapping and no new insights were being registered, showing evidence of data saturation. Table 3 shows the list of stakeholders that were interviewed for this research project.

Interviewee	Professional profile	Company/Area of expertise	Country	Date	Interview duration
Enrico Howe	Shared mopeds market researcher	Unu and Independent	Germany	20.12.2019	0:47:49
Amanda Lam	Marketing Manager and Educator	INVERS	Canada	02.01.2020	0:38:59
Johannes Grueneberg	Head of Sales and Business Development	INVERS	Germany	10.01.2020	0:39:13
Augusting Friedel	Intermodality Strategy Manager	Volkswagen AG	Germany	13.01.2020	0:31:12
Gonzalo Prieto	Head of Operations	LIME	Argentina	13.01.2020	0:26:09
Adriana Garcia Cota	Business Development and Operations	eConduce	Mexico	14.01.2020	0:23:51
Thomas Cooper	CEO	RIDE	Australia	15.01.2020	0:20:29
Manish Saraf	Senior Product Manager	Bounce	India	18.01.2020	0:28:41
Rui Filipe Quintal de Almeida	Co-Founder	Riba Share	Brazil	22.01.2020	0:44:31
Sandra Phillips	CEO and Founder	Movmi	Canada	23.01.2020	0:26:52
Anonymous	Global Expansion Program Manager	Anonymous	-	26.01.2020	0:43:00

Table 2. List of interviewees and details on date and duration of the interview

3.4. Data analysis

According to Leech & Onwuegbuzie (2008), data analysis can be considered as the most demanding aspect of the qualitative research process. To systematically evaluate the data collected, a process of coding is required. A code in qualitative research symbolically assigns a summative or suggestive attribute for a portion of qualitative data (Bauch et al., 2006). Flick (2009) understands coding as the operation by which data is segmented, conceptualised, and reorganised in new ways. Flick (2009) adds that coding includes the ongoing comparison of events, concepts, phenomena, etc. This process enables the development of theories through the process of abstraction. The analysis of the data was carried out by both a pre-coding approach and a regular coding approach. Instead of developing the codes directly from the analysis of the data, a set of codes was pre-conceived, derived from the theoretical background in the literature review section. This deductive approach helps link the research to the existing literature in the topic, having an initial analytical framework as a starting point (Saunders et al., 2016). The unexpected criteria that were gathered through the responses were coded with a new label and were either included in the pre-existing categories or assigned to a new category. This goes in line with the inductive approach which suggests that "theory emerges from the process of data collection, analysis and interpretation" (Saunders et al., 2016, p. 570)

Because the collection and analysis of data have an interactive nature, the constant interaction and iteration helped filter and further cluster codes into categories, which enabled to better identify certain patterns, relationships and emerging themes from the data (Saunders et al., 2016). Having this concept in mind, the final list of factors was consolidated by first cross-referencing the resulting factors from the semi-structured interviews with the factors that were pre-defined in the literature review. The total amount of mentions both from the literature review and the expert interviews were added up to determine their first degree of relevance. This process resulted in a list of 10 factors with a defined number of mentions each. These factors, when analysed, presented different degrees of influence on the outcome of the moped sharing business. With the aim of further understanding how these factors affect the outcome of the business, a second process was carried out where the factors were further categorised by relevance to finally come up with the CSF. For this, the relevance of the factors was determined by analysing their relation to the main activity of the business, their impact on the business costs, their effect on the profits, and finally the implications that these have on the performance of the moped sharing service. The criteria for prioritising the CSF are based on the scheme proposed by Leidecker & Bruno (1984) which is mentioned in section 2.2. This scheme is used to analyse the impact of the factors on the main activity of the business, their impact on the costs, their impact on the profit and their impact on the performance.

3.5. Validity and reliability

Validity and reliability are essential to the application of the grounded theory approach (Madill, Jordan, & Shirley, 2000). On the one hand, validity refers to how the proper way in which results are measured, which is important to ensure objectivity in the process (Kirk & Miller, 1986). To demonstrate the validity and reliability of this study, the framework developed by Shenton (2004) was used. This framework has three main criteria: transferability, credibility and dependability. These criteria can ensure that the research is trustworthy regarding internal validity, and external validity and reliability. Moreover, the study from Morrow (2005) was used to demonstrate the trustworthiness of this research.

According to Drisko (1997), the transferability of research explains that the findings of a study can be used in different contexts. It is demonstrated when enough information is given about the individual carrying out the research, context of the research, the processes, and everything that has to do with the participants so that the reader can resolve how the findings may be transferred. In this study, the eleven participants that were interviewed worked in organizations located in Argentina, Australia, Brazil, Canada, Germany, India, Mexico, and Taiwan. The data collection in the form of interviews took place between 20th December 2019 and 26th January 2020. An exception in the form of an exploratory interview was carried out in October. The duration of the interviews ranged from 20 minutes up to 50 minutes and the questions which were asked can be seen in point 7.4 in the appendix. It was ensured that the selected participants had all relevant hierarchy and experience (of at least 2 years) in the industry to ensure that the responses were trustworthy.

Credibility in a study can be achieved by demonstrating consistency in the research so that the details of the process can be communicated in a clear manner to the readers (Gasson, 2004). Shenton (2004) states in his framework that it is necessary at first for the researcher to familiarise with the culture of the participants to establish some trust. However, in some cases, too many demands can hinder the willingness of participants to take part (Shenton, 2004). In the case of this research, this is more relevant given the nature of my professional position as a student and my lack of exposure in the industry. Therefore, the interviewees were first approached by social media channels like LinkedIn and in some cases, in direct approach in technology conferences. For this purpose, it is important to generate rapport with the participant to enable a positive attitude, a more pleasant conversation and in the end better information quality and quantity. Shenton (2004) also emphasises the importance of random sampling of individuals alleging that it is a requirement for the credibility criterion. In the case of this study, random sampling has been used, provided that the population belonged to the industry and fulfilled the amount of experience requirements. The companies that were scrutinised

for potential participants were randomly selected from looking at moped sharing operator companies in platforms such as *Crunchbase.com* or *The Global Micromobility Map.* Other sources include LinkedIn news feed and other blogs to complete the list. When the final list of companies was rendered, these were fed into LinkedIn, and from there I was able to manually extract a list of 129 potential candidates.

The number of employees from the companies interviewed vary from 5 to 415, except for one who worked for a company that currently hires 300,000+ employees. As mentioned before, the shortlisting of candidates was done by evaluating the relevance of their position and experience of at least more than 2 years in the industry. Because of the generalist approach of this research, managerial positions were targeted, particularly executive positions within the companies or consultant profiles working specifically on moped sharing. The credibility of the information they provided was also verified by comparing their answers with other participants. The themes and patterns identified in the study had all matching opinions from the experts or by comparing with previously researched literature. The new concepts that were collected during an interview were further verified with the new interviewee, and so on. This way, the concepts were added up, verified, and a more robust set of codes was generated.

The framework by Shenton (2004) addresses the tactics to make sure the researcher is getting honest information from the participants. They should be able to refuse, withdraw or remain anonymous in the study. In the case of this study, this was communicated to the participants beforehand. A copy of the study was promised to the participants willing to take part in the study, hence the willingness to contribute with reliable information was clear. Following that, Shenton (2004) underlines that the researcher's background and/or qualifications are an important element that helps create a level of trust from the participant towards the researcher. Most of the invitations were sent via LinkedIn messages, and the qualifications of the author and the purpose of the research were clearly announced in the invitation to take part. Moreover, since LinkedIn messages are directly connected to the author's profile, the participants could directly corroborate the qualifications.

Dependability is defined by Shenton (2004) as the possibility to reproduce the findings of the study by another researcher. In other words, if other researchers repeat the same process the same results will be achieved. Morrow (2005) explains that to attain this, the researcher needs to report the research design and create a roadmap or a chronology of the design process. This needs to include the "(...) data collection and analysis; emerging themes; categories, or models; and analytic memos." (Morrow, 2004, p. 252). In Figure 2, a layout of the research design is provided.

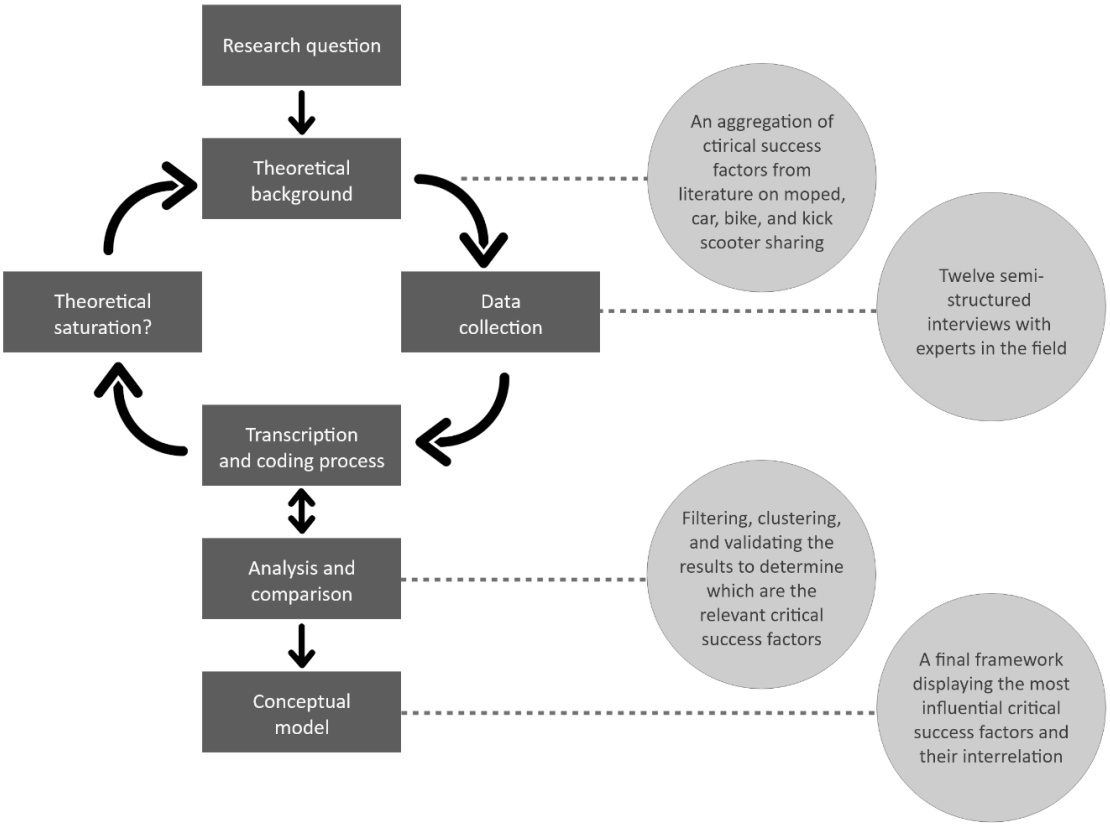

Figure 2. Research design

4. Identifying CSF and their influence on cost optimisation and customer adoption and retention

The data analysis process returned an amount of 129 codes that written down based on concepts mentioned by the experts during the interviews. Based on their input, pre-existent codes from the theoretical background were validated and further enriched with new information. Furthermore, a reorganisation of the categories was carried out in a cyclic process to cluster more concepts into more comprising labels. The cyclic comparison between the theoretical background and the collected data also allowed to synthesise patterns and themes that led to the identification of the most relevant factors. In table 3, the resulting list of factors derived from the theoretical background is shown. On the left side column, the resulting factors are displayed and organised by category and on the top row, the authors that were referenced in the literature review are displayed. The cells that are coloured in dark grey indicate when a certain factor is mentioned in the corresponding literature. The last column

summarises the number of times certain factor was mentioned in the totality of the reviewed literature.

Category	Author / Factor	Murr & Phillips (2016)	Kortum et al. (2016)	Médard de Chardon et al. (2017)	Krümmel et al. (2019)	Axsen & Sovacool (2019)	Machado, Hue & Berssaneti (2018)	Howe & Jakobsen (2019)	Shaheen & Cohen (2018)	Deloitte (2016)	Mentions
Demographic factors	*Population*	■	■	■			■				4
Cultural factors	*Knowledge and perception*	■		■				■			3
Infrastructural factors	*City layout*	■		■	■		■				4
	Public transp. availability	■									4
Climate factors	*Weather*	■		■	■						3
Legal factors	*Cooperation w/ authorities*	■		■	■				■		4
	Norms and regulations			■	■				■		3
Operational factors	*Fleet management*				■					■	2
	Communication and customer service				■						1
	Operational efficiency				■					■	1

Table 3. Analysis of the number of mentions on factors in the theoretical background

Table 4 shows in a similar manner the factors that are mentioned but in this case by the experts during the interviews. The highlighted cells in the table indicate which experts made any reference on the subject. In some interviews, although some factors were mentioned more than once in the same conversation, the total number of mentions was considered as one.

Category	Expert / Factor	EH	AL	JG	AF	GP	AG	TC	MS	RFQ	SP	NN	Mentions
Demographic factors	*Population*				■	■				■			3
Cultural factors	*Knowledge and perception*	■	■	■	■		■			■			6
Infrastructural factors	*Public transp. availability*	■	■	■						■	■	■	6
	City layout	■	■	■			■			■		■	6
Climate factors	*Weather*	■	■	■			■	■				■	6
Legal factors	*Cooperation with authorities*	■	■			■	■				■	■	6
	Norms and regulations		■		■		■	■		■	■	■	7
Operational factors	*Communication and customer service*				■						■	■	6
	Fleet and business management	■	■	■	■		■		■	■	■		8
	Operational efficiency	■	■	■	■		■				■	■	8

Table 4. Analysis of number of mentions on factors by experts in the field. MP: Murr & Phillips, 2016; KSSB: Kortum et al., 2016; MCT: Médard de Chardon et al., 2017; KGBM: Krümmel et al., 2019; AS: Axsen & Sovacool, 2019; MHB: Machado, Hue & Berssaneti, 2018; EH: Howe, 2018, Howe & Jakobsen, 2019; SH: Shaheen, Cohen, Jaffee, et al., 2016.

Table 5 summarises the findings regarding the mentions from the two previous tables and organises the factors by the amount of combined mentions.

Factor	Mentions by interviewees	Mentions in the literature	Total mentions
Fleet and business management	8	2	10
Norms and regulations	7	3	10
City layout	6	4	10
Cooperation with authorities	6	4	10
Knowledge and perception	6	3	9
Weather	6	3	9
Population	3	4	7
Public transp. availability	6	1	7
Operational efficiency	7	1	8
Communication and customer service	6	1	7

Table 5. Summary of total amount of mentions of relevant factors

Following the initial selection of important factors, a second assessment is carried out by using the scheme proposed by Leidecker & Bruno (1984). The information provided by the literature review and the input from the expert was used as a base to assess the degree of importance these have in relation to the four areas of impact proposed by the authors. The qualitative assessment does represent a degree of subjectivity by the author when analysing the information. The mentioned areas of impact to be analysed are *the relationships they have to the main activity of the business; the impact on the costs; the impact on the profits; and the impact on performance*. The resulting assessment is shown in table 6 and the factors that are highlighted are considered as the resulting CSF.

Factor	**Relation to the main activity of the business**	**Impact on the business costs**	**Impact on the profits**	**Impact on performance**
Fleet and business management	VERY HIGH	VERY HIGH	HIGH	VERY HIGH
Norms and regulations	VERY HIGH	VERY HIGH	VERY HIGH	HIGH
Operational efficiency	VERY HIGH	VERY HIGH	VERY HIGH	HIGH
Weather	MID	HIGH	VERY HIGH	HIGH
Cooperation with authorities	VERY HIGH	HIGH	HIGH	VERY HIGH
City layout	HIGH	VERY HIGH	HIGH	HIGH
Public transp. availability	*HIGH*	*MID*	*HIGH*	*HIGH*
Population	HIGH	LOW	HIGH	MID
Knowledge and perception	MID	MID	MID	HIGH
Communication and customer service	HIGH	MID	MID	MID

Table 6. Assessment on the degree of importance of the factors by Leidecker & Bruno (1984)

The factors were organised by order of influence as seen on Table 6, and the last three factors, although had enough mentions to be considered relevant, didn't have as much impact across the four different areas as the ones that are highlighted on table 6. For example, the factor population, on the one hand, is dependent on the influence of other factors. Although population is strongly related to the main activity of the business (since it's a B2C business and relies on scalability), the degree of influence it has on costs and performance is subject to, for example, density, city layout, culture of the market, norms and regulations, etc. On the same line, knowledge and perception factor can condition the performance of a business, but it is more or less influential depending on the region. Since it cannot be generalised in practice given the differences between cultures from region to region, this factor deserves a deeper analysis to understand its implication on a general level. Moreover, the knowledge and perception might hinder the initial performance of moped sharing development, but it's an area that can be tackled if well managed by the right communication strategies. This leads to

communication and customer service, which is crucial to develop customer adoption, perception of the brand, and education, and are related to the main activities of the business. Nevertheless, it has considered more of an important influential factor rather than a CSF. The rest of the highlighted factors have been shortlisted as the CSF, for which the following section elaborates on.

4.1. Defining the identified CSF and their function within the moped sharing ecosystem

The value that this study provides does not solely rely on the discovery of new information that hadn't been contemplated before but also consolidates concepts that are applied to other types of modalities and validate them in the moped sharing context. The factors presented in this study are indeed mentioned in the literature, but most of these factors are reviewed in the context of other shared mobility modalities. Additionally, the literature that was reviewed treated the factors on a different level, being either too specific and focusing on the study of a particular factor (for example geographical optimisation for fleet redistribution) or mentioning the factors on a higher level to support another unit of analysis, like a holistic overview of the shared mobility landscape. Moreover, the recollection of factors was taken from different sources that combined car sharing, bike sharing, and kick-scooter sharing. No studies have focused so far on the specific factors that influence the moped shared industry, and the reports and publications that treat this specific modality have a focus on the market development rather than the operational side of the business itself. Hence, this research is especially valuable because of the level of analysis, and the focus on the moped sharing industry, which shows great potential in the near future and still presents a lack of academic attention.

This section dives into the shortlisted CSF. Each factor is expanded, and the most important findings are explained, both from the experts' point of view, as well as the link these inputs, have to the literature. The selected CSF (shown on table 6) are analysed individually by finding the connections and explaining in which ways they affect the moped sharing business ecosystem. In this section, the particular findings from the theoretical background are laid out, as well as the results derived from the expert interviews. The connections between the literature and the expert interviews are explained, in an effort to validate these concepts and expand on the knowledge. Furthermore, new information derived exclusively from the qualitative interviews is also included in the description of each factor to expand the knowledge on that particular concept. Finally, a list at the end of each CSF summarises the connections between the elements within the factors, the user adoption, and the cost optimisation, ultimately leading to the development of the conceptual model which is explained later

in section 4.2. Table 7 helps to understand to which author belong the acronyms used in the description of the CSF.

Acronym	Expert
EH	Enrico Howe
AL	Amanda Lam
JG	Johannes Grueneberg
AF	Augustin Friedel
GP	Gonzalo Prieto
AG	Adriana Garcia Cota
TC	Thomas Cooper
MS	Manish Saraf
RFQ	Rui Filipe Quintal de Almeida
SP	Sandra Phillips
NN	Anonymous

Table 7. Acronyms from experts

The following CSF are analysed and displayed in order of importance (or degree of influence). These are *fleet and business management, norms and regulations, operational efficiency, weather, cooperation with authorities, city layout, and public transport availability* in this respecting order.

Fleet and business management

Fleet management is related to ensuring the maximum and efficient utilisation of the vehicles. They must be well maintained but also distributed in a way that there is a good density of vehicles within the operating business area (EH). The redistribution needs to be focused on high utilization areas depending on the time of the day and it is also important to keep a good balance between residential areas and central hubs (AL). Fleet rebalancing to boost availability can be taken to the next level if data is effectively used (AG). This means anticipating who is going to take the moped where, who else is going to pick it up from that point, and where is that customer most likely headed to. The use of artificial intelligence algorithms can be used to create prediction models which can be decisive to push these predictions to the next level to improve the utilisation rates of the vehicles (AG). The density,

which is related to availability, is of utter importance in a city (AF). If the distribution is effective, then the mopeds that are offered also need to be in good shape. Maintenance means that the mopeds need to work correctly, be clean, have the helmets in place and enough battery charge (EH). In summary, reliability and convenience are the pillars of fleet management, and all this needs to be combined with easy-to-understand user experience (SP).

Fleet management

- *Data leverage positively affects efficient rebalancing*
- *Efficient rebalancing positively affects availability and reliability*
- *Maintenance positively affects availability and reliability*
- *Availability and reliability positively affect adoption*

Norms and regulations

Murr & Phillips (2016) refer as an influential concept the presence of bylaws or tenders that support shared mobility with, for example, benefits on parking permits, which usually are created to foster the development of shared mobility. Krümmel et al. (2019) explain that different regions might require different vehicle adaptations to satisfy the transit regulation, something that can have an impact on the costs of capital. On the other hand, AL explains that if traffic rules treat mopeds like cars like in North America (meaning that riders can't swerve between cars), it can negatively affect the preference for mopeds, since it takes away the characteristic flexibility of the vehicle. In this scenario, AL says that if people have to travel shorter distances, other micro-mobility alternatives would be preferred (AL). AF, SP and LFQ agree that driver's licence requirements can be a big barrier for customer adoption if riders need a special license to drive a moped. European countries like Germany or Spain allow citizens to ride mopeds below 50cc with the same driver's license needed for the car. However, that's not the same case for Switzerland, where the need for a special license for mopeds, combined a lower population led to lack of customer adoption due to not being able to register enough users (SP). However, in this case of San Pablo (Brazil), the population is around twelve million inhabitants, and although the proportion of riders is lower, two and a half million people own this kind of licence (RFQ). Moving on to the regulation of the fleet itself, AF and AL both say that the restriction of permits in the form of fleet number cap can significantly harm the business profitability. SP states that restrictive insurance regulations can extensively affect the fleet and operational costs. Regarding parking, EH explains that the current parking for mopeds like in the city of Berlin is flexible, which fosters adoption, however, this can change if it becomes a nuisance for the citizens and authorities are forced to enforce

the existing regulations. AF mentions that if these laws come into practice, the fines received for misplacing the vehicles might have an impact on the business profitability. SP concludes by adding that as moped sharing services proliferate, it is likely that regulations on this matter will become tighter.

Norms and regulations

- *Existence of bylaws that support moped sharing development positively affect fleet management*
- *Vehicle adaptation requirement negatively affect fleet and business management*
- *Restrictive traffic rules for moped riding negatively affects adoption*
- *Special driver's licence for moped requirement negatively affects adoption*
- *Restrictive permits and insurance for mopeds negatively affects operational costs*
- *Tighter parking regulations negatively affect fleet management and adoption*

Operational efficiency

Krummel et al. (2019) define the elements of operations as storage, relocation, repairing, cleaning, and charging. The authors highlight that relocating and charging carry the largest costs, accounting up to 50 per cent of the operational costs, also mentioned by AG. Operational costs, according to almost all interviewees, is one of the most relevant factors, and it is intimately related to fleet and business management. NN emphasises that most of the efforts operators make to stay competitive in the market are driven towards operational cost optimisation. So, keeping the fleet running with a high utilisation rate and minimised downtime is fundamental to ensure the maximum return on capital (AL). AL highlights the fact that data becomes a valuable asset to not only assess an effective redistribution of the fleet but also to adopt predictive maintenance for this matter. Dead vehicles parked on the road mean loss of revenue and customers loss, as well as a deterioration of the brand (AL). AF states that keeping the headquarters with a lean seat up is also important when it comes to cost control. This is due to two reasons: first, companies need to be flexible so that they can adapt to the quick changes of a volatile market. Second, corporate configurations can have the risk of involving costly executives that may have an impact on the budget allocation. NN explains that high overhead costs and lack of flexibility, with an additional risk of drifting away from the overall corporate vision, can result in the failure of a business as it happened with Coup in Berlin.

Operational efficiency

- *High utilisation rate positively affects cost optimisation*
- *Minimised fleet downtime positively affects cost optimisation*
- *Lean management and flexibility positively affect cost optimisation*
- *Effective fleet management positively affects operational efficiency*

Weather

Murr & Phillips (2016) mention that in regions with cold and snowy weather people will choose heated public transport or private vehicles -an argument that was backed by most of the interviewees-. Médard de Chardon et al. (2017), JG, and AF explain that in colder weathers the service is not available in certain in colder periods, which affects the reliability and dependence of the service throughout the year, hence, the fleet management (in terms of cost) and user adoption is negatively affected. EH explains that ice and snow in a colder climate not only affect the comfort of commuting but also makes the ride unsafe when there is ice or snow on the roads. TC gives the example of a drop of 50 to 60 per cent of the use of the service in cold seasons against a 10 to 15 per cent drop in more template weathers. The authors add that very hot weather, on the other hand, can discourage the use of bike sharing since people don't want to sweat too much while commuting. JG adds that the amount of rain throughout the year and cold temperatures are the climatic factors that most influence negatively the use of the service, which is also mentioned by Krümmel et al. (2019). EH and AL argue that milder weather also influences the pre-existing moped culture and presence, which positively affects adoption because people are already used to the vehicle. This requires fewer efforts on educating potential customers and growing awareness over an almost inexistent base. Flooding like it sometimes occur in monsoon season in parts of Southeast Asia[3] can also portray a threat to the fleet (NN).

[3] http://www.mapreport.com/citysubtopics/southeast_asia-d-w.html

Weather

- *Cold weather negatively affects adoption and fleet management*
- *Too hot weather positively affects preference for moped over other micro mobility alternatives*
- *More template weather positively affects pre-existing mopeds culture, hence, adoption*
- *Flooding regions negatively affects fleet management*

Cooperation with authorities

In the literature, Murr & Phillips (2016) and Médard de Chardon et al. (2017) highlight the importance of the support from the authorities regarding alternative mobility solutions to complement the existing transport infrastructure. This argument is shared by Adriana Garcia Cota (AG) and Thomas Cooper (TC) who also add that cooperation is important because the operation of the fleet requires the use of public space, which is managed by the city. Anonymous interviewee (NN) adds that the vehicles also require energy, whose price is regulated by the authorities and which ultimately impacts on the profitability of the company and the pricing of the service. Moreover, Murr & Phillips (2016) argue that if there are sustainability plans within the city agenda, it could be considered as an indicator that the city will be more willing to collaborate in efforts to reduce CO2 emissions, especially when the fleet is electrically powered. EH validates this concept by saying mentioning that pulling people out of their personal cars and offering clean alternatives such as electric shared mobility services falls within these solutions. The openness of local authorities towards integrating new mobility platforms is fundamental for efficient cooperation, which in the end results in a sustainable business over time and a greater value creation for citizens (Krümmel et al., 2019). Gonzalo Prieto (GP) reaffirms this argument by saying that it is highly recommendable to invest in good relationships with the city authorities to develop sustainable policies that work both for the public and the private sector. On the other hand, EH mentions that strategies need to be formulated to ensure that spaces are used fairly. AL explains that mopeds can be a part of the solution for this problem because they occupy less space than cars both in parking and in traffic. Additionally, SP and AL explain that a good practice to foster good relationships with the government is through educational programs for shared mopeds. By educating people, companies are not only promoting the service the use of shared mopeds and the service itself but also contributing to safer traffic, something that is well received by authorities.

Cooperation with authorities

- *Support from authorities has a positive impact on fleet management and operational efficiency*
- *Attitude of the city towards sustainability has a positive impact on support from authorities towards shared mobility*
- *Educational programs for riders have a positive impact on support from authorities towards shared mobility*

City layout

In the literature, Machado, Hue & Berssaneti (2018) and Médard de Chardon et al. (2017) mention that cycling lanes or infrastructure can promote cycling, can increase safety and the perception of safety from people. Sandra Phillips (SP) adds that this concept is important for moped sharing adoption given a bigger perception of danger, especially in, for example, North American populations which are more "nervous" riders. Murr & Phillips (2016), Médard de Chardon et al. (2017), and Krümmel et al. (2019) argue that hillier terrains and streets built with materials like cobblestones could make mopeds more desirable for commuting over other alternatives like kick scooters. This is also backed up by Enrico Howe (EH) and Johannes Gruenberg (JG) who argue that cobblestone streets can be uncomfortable and more dangerous when using a kick scooter over a moped and the steepness of the roads can also be a factor that determines whether commuters prefer using bikes or vehicles with motors. Krümmel et al. (2019) mention that the range of mopeds at the same time allows traveling greater distances, which means this vehicle can be an advantage in bigger cities. Rui Filipe Quintal de Almeida (RFQ) corroborates this when explaining his experience in San Pablo, Brazil, where people travel between 8 to 12 kilometres from their home to their workplaces and leave their cars in the peripheries to then take the transport, or in other cases shared mobility solutions. Also, RFQ adds that places are far apart from each other within the city, so people prefer other alternatives rather than bicycles as these can make you sweaty or tired, so the moped can be a good solution for this. Amanda Lam (AL) argues that cities that have a denser configuration are ideal for multimodal commuting, which encourages moped sharing adoption, whereas in more spread out cities it's more difficult to distribute the fleet efficiently. AL explains that when cities are spread out as mentioned in the first example, people tend to opt for car ownership as shared mobility services are not suited to fulfil the needed availability in more isolated residential areas. Moreover, Augustin Friedel (AF), RFQ and JG state that the progressive problem with parking in denser cities leaves room for alternatives like

moped sharing due to their flexibility, as in many regions' mopeds can still be parked on the sidewalk, and occupy less space overall.

Public transport availability

Murr & Phillips (2016) consider commuting behaviour as a relevant concept, linked to public transport availability. AL, SP, EH and JG explain that efficient public transportation positively influences the growth and success of shared mobility as moped sharing complements it by providing a commuting alternative for the blind spots. When there is lack of efficient public transport infrastructure, the first option people go to is the private car and building a shared moped network where ownership is predominant among commuters can be very hard (JG,SP). When public transport is very well developed (hyperconnected) like the city of New York or Tokyo there is less reason to use other mobility options (SP). AG adds that these blind spots are especially important when exploiting them through the use of data for a strategical distribution of the fleet. The development of Mobility as a Service (Maas) and the integration of public transport would encourage the use of all types of micro mobility, as it will make the travelling booking more frictionless (TC).

City layout hypotheses

- *Special lanes allowed for mopeds increase adoption*
- *Hillier terrains and rough materials on streets increase preference of moped over micro mobility vehicles*
- *Denser cities increase adoption but if they are too spread out, it negatively affects it*
- *Bigger cities increase adoption*
- *Lack of parking increases adoption*

Public transport availability

- *Good public transport network has a positive impact on adoption*
- *Poorly developed public transport has a negative impact on adoption*
- *Hyperconnected public transport has a negative impact on adoption*

4.2. Conceptual model

This section synthesises the definitions that were covered in section 4.1. Figure 3 shows a conceptual model that explains the interrelations between the factors, and how these affect customer adoption and retention, and cost optimisation. These two concepts are then the ones that determine the outcome of moped sharing businesses in terms of economic profit, contribution to the environment, and social welfare. The model displays the external CSF at the bottom establishes the influence these have on the internal CSF as it has previously been established. The internal CSF at the same time have a bilateral relation both with customer adoption and retention, and the cost optimisation. These two concepts need to have a positive outcome to ensure economic profitability, which in the end can be invested in continuous improvement of the internal CSF. This feedback loop will create a model that drives the business to be sustainable and to deliver an effective service that creates economic, environmental and social value.

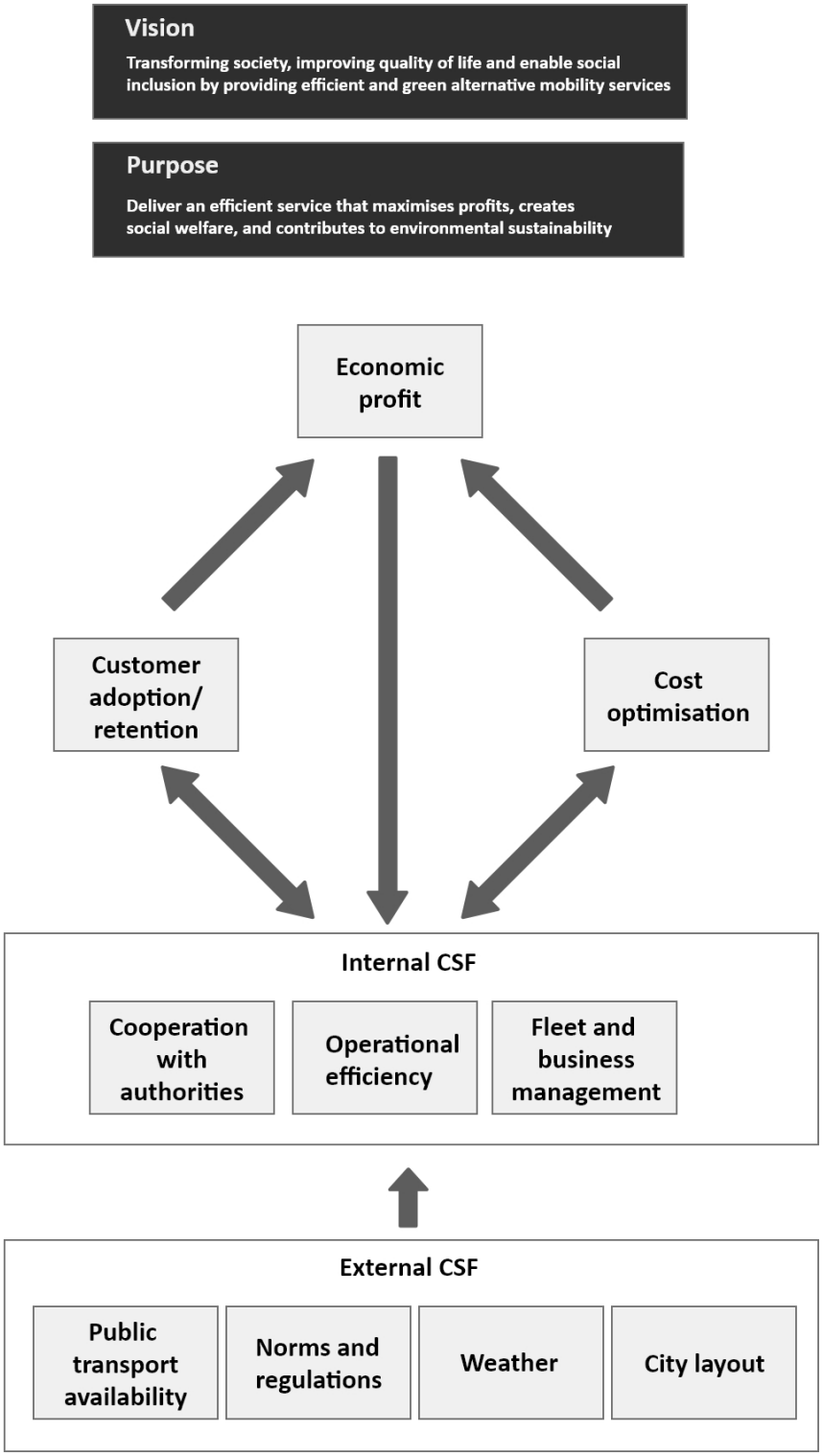

Figure 3. Conceptual model

5. Conclusion

Going back to the initial steps of the study, it is helpful to refresh the research question to further elaborate on the conclusions: "w*hich are the most important factors that need to be addressed by moped sharing operators to ensure sustainable competitive performance in a new industry ecosystem?".* To reply to the question, the CSF in order of importance are *fleet and business management, norms and regulations, operational efficiency, weather, cooperation with authorities, city layout, and public transport availability.* This importance of the CSF is defined not only by the relevance they have in the literature and the experts' testimonials but also by the degree of impact they have on different areas of the business. The resulting conceptual model shown in figure 3 depicts the interrelation of these CSF within the industry ecosystem and establishes a relation between them and two crucial concepts: customer acquisition and retention, and cost optimisation. The positive outcome of these two concepts is finally manifested in economic profit, which at the same time is necessary to develop a sustainable business in a competitive market. With a fair competition and enabling rules, profitable moped sharing business can successfully provide a service that brings social welfare and environmental sustainability. Although the CSF were the focus of this research, other influential factors that were identified are also listed and can be referred to in the appendix on point 7.5.

The first group of CSF that appear in the conceptual model are external (or environmental) CSF, and should be carefully assessed before conceiving the idea of starting a new business in a determined market. Reflecting on the conceptual model depicted in figure 3, the external CSF are the first ones that need to be considered when starting a new moped sharing business. The reason for this is that these fall outside the control of the company and have enough impact to define the way a business strategy needs to be formulated, or even considered as feasible. These external factors pre-determine how a society lives, what their attitude towards mopeds is, and how their commuting behaviour manifests. These are pre-conditions that need to be taken into account when analysing a market to determine the potential success of the business and can seriously hinder its development if not carefully assessed. If internal factors are aligned to the pre-conditions that external factors dictate, the strategy has more chances to be successful in terms of profit and sustainability. In other words, external factors condition the way internal CSF need to be managed for an optimal outcome.

Moving on to more manageable external CSF from the firm's perspective, one of the key takeaways of this research is that shared mopeds operators need to establish good relationships with the city authorities as they are the ones that set the norms and regulations of the playground. If policy and support from authorities are not aligned with moped sharing services rolling out in the city, then it

would be very difficult for operators to make enough revenue if the conditions don't allow it. However, we see that governments are in general positive towards private companies that want to provide with alternative solutions that help tackle the main issues concerning mobility cities. However, in the field of experience, public systems don't represent a black and white scenario, but a collaboration needs to be set in place to jointly shape the landscape with an agile trial and error approach. The more the city wins in terms of facilitating a solution for the problems it faces, the more benefits operators should be granted to scale their business and provide an even better service.

Operators at the same time need to focus their efforts on optimising the fleet utilisation. If the fleet is not running at its full potential, there is less revenue coming in which is needed to scale to gain competitive advantage, and so the cycle goes. To achieve higher utilisation of the fleet, the vehicles need to be reliable to the people that use it. This means that they need to be strategically distributed for people to always be able to reach them, well maintained, charged, and connected to the system without errors. An efficient service will create a behaviour of dependency from the users which can be built around public transportation, and away from the private cars. The main resources companies possess to ensure an effective utilisation is technology and channels of communication. These two elements enable the tools necessary to tackle the challenges of managing the fleet with all the consideration previously mentioned.

If this cyclic feedback is well managed, a desirable outcome is then manifested in the form of economic profit, contributions to the environment, and social welfare. The contribution to the environment is especially relevant when the fleet of mopeds is electric, thus, as mention before, contribution to a reduction on CO2 emissions in line with the environmental goals most regions establish. Social welfare is related to contributing to the solution that solves the problem of traffic, lack of space and rapid expansion of the cities. Helping cities tackle these problems in mobility which are progressively increasing over time, means not only that citizens have more alternatives and flexibility for commuting and interacting within the city, but also enables the inclusion of areas where the public infrastructure can't cover fast enough.

In the end, the drive for policy enforcements on the city side and the reason why companies thrive to develop and push the limits of customer experience is to generate value for citizens, thus improving the welfare of society. Although each party might have different means to ensure their vision, this revolves around the improvement of society through efficient and sustainable services that people can benefit from. On the other side, governments should understand that the disruption of mobility brings opportunities but also challenges that need to be tackled in an ongoing basis with the right system of permits, concessions, restrictions, and performance-based rewards. The design of these

policies in a city should be planned with open participation from companies to achieve economic sustainability under fair market competition.

5.1. Added values

The research presents several managerial implications. The conceptual framework is mainly focused on startups who are looking into starting a new moped sharing business. However, it can also be useful for established players who are looking to gain a competitive advantage in their market and/or scale their business to other markets. The conceptual framework can help these organisations assess the different CSF that need to be considered when facing the new endeavour. It portrays a holistic view on how the different pieces of the ecosystem work and interact with each other, and how these can be balanced by creating a strategy that foresees any potential contingencies along the way.

The study also serves to fill the lack of literature that currently exists for the moped sharing topic in academia. With the explosion of shared mobility services that cities around the world have experienced, the majority of academic papers are focused on the most popular shared mobility modalities which are car sharing, bike sharing and kick scooter sharing. By introducing moped sharing services into the academic map, not only a gap is being addressed, but also the definition of moped sharing is being reinforced, which is often confused and eclipsed with the kick scooter ones. Moreover, the topic has been growing and it is becoming more relevant. Hence, this study portrays an interesting general starting point for further research.

The city authorities can also make use of this study to better understand how the industry operates and how it is affected by policy. When private and public sector cooperate, it is most efficient if both parties are talking to each other at eye level and understand how the actions of one side can dramatically affect the outcome of the other. Since a win-win situation is what ultimately creates social, economic, and environmental value, with the right knowledge authorities can have a better judgement when defining the rules. If the city knows what is it operators need to be economically sustainable, the city officials can arbitrate their resources to create fair rules and provide a reasonable playground for competition, ensuring that the well-being of the citizens is not affected in the process.

Finally, the moped sharing industry is a rapidly growing sector in the shared mobility ecosystem. As shared mopeds are steadily stepping into the limelight, more information, studies, articles, and conferences need to be specifically addressed to this modality. New moped sharing companies are being founded around the world, and each one encounters unique experiences that should ideally be shared with the community to realise the vision (hopefully) everyone shares, which is providing an

inclusive service that brings wealth, social welfare and environmental responsibility. Researches like this one can help kickstart the theoretical support this industry needs.

5.2. Limitations

The study comprises a general approach to the analysis of the factors that affect businesses, authorities, and people. Because of this scope, a decision had to be made in how specific the analysis of each factor would have to be. Therefore, a deeper level would have been counterproductive for the aim of the research. Following this line, another limitation is that the qualitative interviews were mostly done with stakeholders belonging mostly to the business environment, so the perspective of the study can be biased. Nevertheless, some participants who had more of an external consulting profile have been also interviewed and provided a more objective point of view. However, having broadened the data collection to people working in the government, and also experts on shared mobility regulations might have provided further insights that could have been useful in the study. The same applies to data collection from the social stakeholder. The point of view from potential users and people indirectly affected by moped sharing could have contributed with more insights to the topic, but again, it falls within the selected scope that was chosen for this research. Finally, some limitations were restricted because of the anonymity that some participants requested related to certain examples.

5.3. Further research

What is interesting about establishing a generalist conceptual model is that it can be used as a tool to expand the research into a variety of more focused studies. First, the analysis of all the factors that are presented in the study can be used as a starting point for deep-diving into each one of them. The focus can be set on a particular factor and a deep level analysis can be carried out on its implications, its further interrelations, and its influence on different business cases. Furthermore, a city index can be elaborated by analysing different cities in different regions and assigning a score for moped sharing "friendliness", similar to what Murr & Phillps (2016) present in their research. This way a "risk map" could be compiled based on the score assigned to different cities in certain regions. A study like this can also be made on a higher level, including all factors, or more specifically using different factor groups. In the latter for example, a city score of "cultural compatibility index" or "climatic feasibility index" can be compiled. Furthermore, more research can be made by analysing business cases with the help of the framework developed in this study. Finally, research can also be focused on the people and how different cultures relate to moped sharing service by collecting data through surveys and focusing on the cultural factors of the ecosystem.

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7.Appendix

7.1. Literature review process

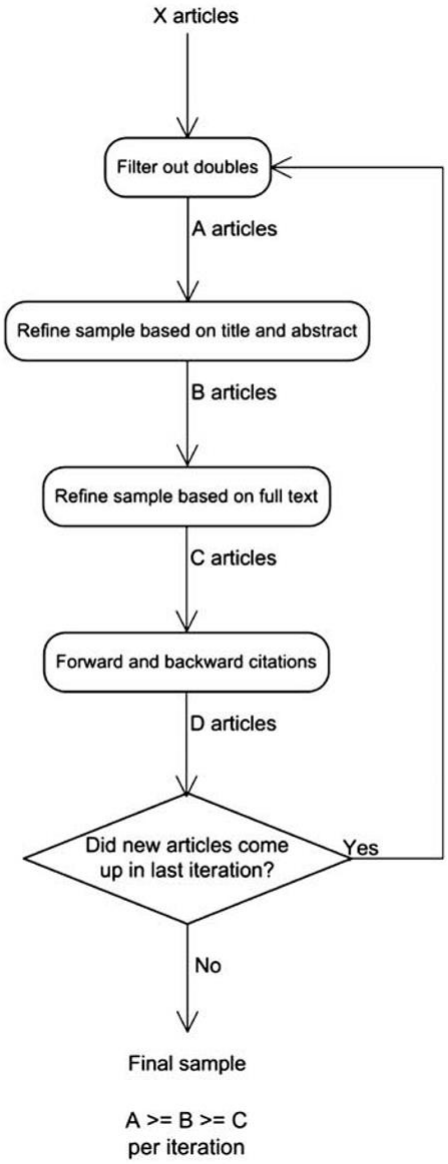

Figure 4. Literature review method by Wolfswinkel, Furtmueller, & Wilderom (2013)

7.2. Search strings

Table 5 presents a list of the different strings used to search for relevant academic articles on platforms like SCOPUS, Google Scholar, and general Google searches.

Most relevant search strings
Carsharing OR “car sharing”
TITLE-ABS(Bikesharing OR “bike sharing” OR (shared AND (bikes OR bicycles)))
“scooter sharing” OR “kick scooter sharing” OR “scootersharing”
“shared economy”
“shared mobility”
“emerging markets”
TITLE-ABS(“mobility as a service” OR “MaaS”)
TITLE-ABS((business AND expansion)
TITLE-ABS((key OR critical) AND “success factors”)
TITLE-ABS((key OR critical) AND “success factors” AND “identification”)
TITLE-ABS (("shared mobility" AND ((critical OR key OR success) AND factors))
TITLE-ABS ("scooter sharing" AND ((critical OR key OR success) AND factors))
TITLE-ABS ("moped sharing" AND ((critical OR key OR success) AND factors))
TITLE-ABS (("car-sharing" OR carsharing) AND ((critical OR key OR success) AND factors))
TITLE-ABS (("bicycle sharing" OR bikesharing) AND ((critical OR key OR success) AND factors))
TITLE-ABS ("success factors" AND (assessing OR assessment))
TITLE-ABS-KEY ("critical success factor" AND identification)

Table 8. Most relevant search strings

7.3. Original graphic from Machado et al. (2018)

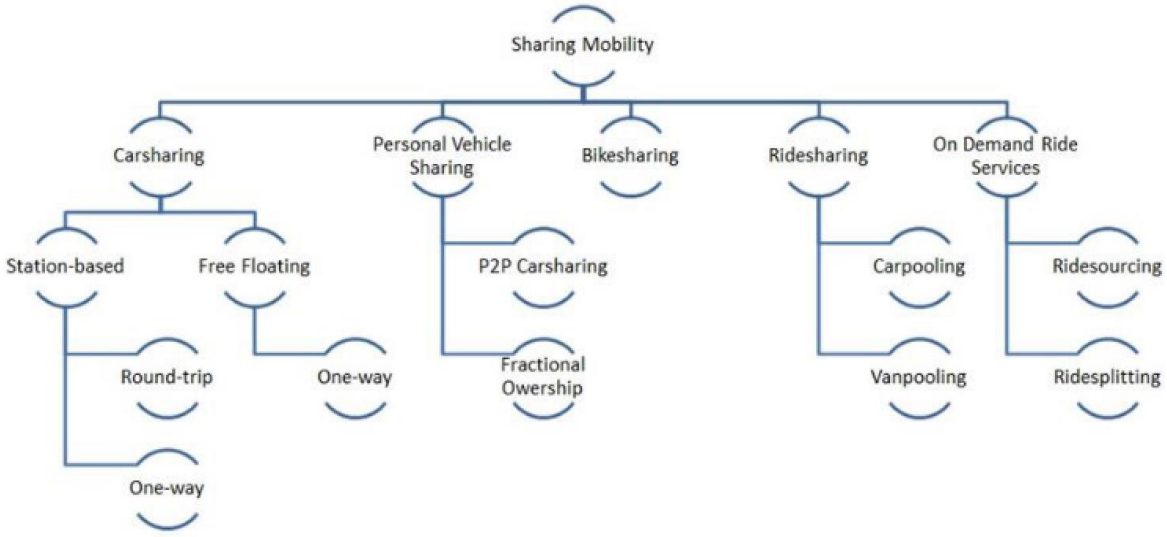

Figure 5. Original hierarchy graphic by Machado et al. (2018)

7.4.Interview protocol

First contact by email with potential interviewee:

Search method will be mainly via LinkedIn, referrals from colleagues that work or do research in the mobility industry, and professionals I have already been in touch with. Gill, Stewart, Treasure, & Chadwick (2008) suggest that before conducting an interview, it is best when the interviewees are informed beforehand about the study details and ensuring them that their anonymity and confidentiality is being respected if they wish so.

The structure of the email message will be as following:

- Who I am and where I am studying
- Purpose of the message
- Brief sentence that summarises the master thesis
- Personalised section explaining why I choose him/her in particular
- Mention the benefits: results will be shared with the interviewee and his name can be mentioned if the thesis is also published as an academic paper.

Interview design:

Interviewee name:

Company:

Position:

Part 1:

1. Brief introduction to the master thesis.
    a. Personal introduction
    b. What my thesis is about
    c. My personal motivation
    d. What I expect from this interview
    e. Mention that it is not necessary to respond to all questions if he/she doesn't feel comfortable about it
2. Questions about moped sharing services
    a. What are the strengths and weaknesses of shared mopeds against other micro-mobility alternatives such as e-scooters and e-bikes (especially taking in account the explosion of competition we have experienced in the last years)?
    b. What are the most challenging aspects of the business? (Operations, marketing, finance, etc.)
    c. What do you consider are the key success factors for a successful shared moped service deployment? (Make sure to include all the PESTLEE analysis factors mentioned in the preliminary framework if the interview doesn't touch the subject (demographics, geography, culture, infrastructure, climate, market, laws and regulations, economy, technology)

d. Having talked before about the success factors, can you mention the 5 most important that first come to mind?
e. Do you think that cultural differences from region to region play a major role when it comes to user adoption?
f. How do you see the rapid evolution of this market and what are the main reasons you think moped sharing is becoming so popular?
g. If you had the task of expanding the business operations internationally, which region, country or city do you think is most attractive? Why?

3. More questions are to be generated over patterns that start generating from the responses of different interviewees.

7.5.Influencing additional factors

The additional factors are not meant to be considered negligible but have indeed less repercussion on determining the success of a moped sharing business. However, with the right tools from an operational point of view, these factors can be managed and used in the operator's benefit. These additional factors are shown with their brief definition on table 9.

Additional factors

Technology
Communication and customer service
Population
Insurance
Vandalism
Sustainability
Knowledge and perception
Driving safety
Ownership culture
Traffic
Public transport system integration
Population
Market overview
Purchasing power

Category	Factor	Description	Number of mentions
Demographic factors	*Population*	Size of the population and density, average age, average household size, gender, and educational level	3
Cultural factors	*Knowledge and perception*	Adoption of micro-mobility vehicles such as mopeds, as well as previous knowledge of shared mobility services, and social media interaction	6
	Vandalism	Inappropriate use or damage of shared mobility vehicles	3

	Driving safety	How safely people drive or how people respect traffic rules and micro-mobility drivers, as well as how sensitive are micro-mobility riders towards perceived danger	3
	Sustainability	How the mindset of people and authorities is towards sustainability	3
Infrastructural factors	*Traffic*	The level of traffic in a certain city, which is related to commuting time and commuting behaviour	2
	Public transportation availability	Available public transport types, number of services they offer and the daily usage	7
	City layout	Wideness of streets, sidewalk configuration, parking spaces and existence of bicycle lanes, as well as steepness of terrain, and characteristics of the roads (materials and condition)	6
Climate factors	*Weather*	Average temperature and its variation between seasons, as well as amount of snow, wind, rains, and sunshine.	6
Legal factors	*Cooperation with authorities*	Openness and support from authorities towards shared mobility initiatives, i.e. sustainability goals, flexibility on regulations	6
	Norms and regulations	Established rules for driving the vehicles, like requirements for helmet use, driving licence, speed limits, and vehicle compliance, parking regulations, and operational restrictions	7
Economic factors	*Market overview*	Availability of locally produced of vehicles, and barriers for importing vehicles and parts	4
	Purchasing power	How much money people can spend for vehicles or for commuting	3
	Insurance for the fleet	The special insurance shared mopeds require	1
Operational factors	*Communication and customer service*	The way operators communicate with the community in terms of marketing, education and customer service	3
	Fleet and business management	All aspects that are involved in keeping the fleet running	10
	Operational optimisation	The efforts to leverage resources to optimise utilisation and reduce operational costs	6
	Technology and UX	What and how hardware and software are used to gain competitive advantage	4

Table 9. Factors derived from experts' interviews and their definition

7.6. Critical success factors from literature review

MP	(Murr & Phillips, 2016)
KSSB	(Kortum et al., 2016)
MCT	(Médard de Chardon et al., 2017)
KGBM	(Krümmel et al., 2019)
AS	(Axsen & Sovacool, 2019)
MHB	(Machado, Hue & Berssaneti, 2018)
EH	(Howe, 2018) & (Howe & Jakobsen, 2019)
SH	(Shaheen, Cohen, Jaffee, et al., 2016)

Table 10.Reference abbreviations for the pre-conceived framework of CSF

Category	**Factor**	**Source**	**Description**
Demographic factors	Population (size/density)	MP; KSSB; MCT; MHB	MP: size of the area the city covers and number of inhabitants in it, which is defined by the density KSSB: Interestingly, the results show that, on average, each additional individual in a household reduces the average vehicle trips by almost one day MCT: Higher population density is related to performance of the bikesharing service KSSB: Population, gender breakdown, median age, education levels, average household levels, average household size
	Age and gender	KSSB	
	Educational level	KSSB	
	Average household size	KSSB	
Geography	Steepness of terrain	MP; MCT; KGBM; MHB	MP: Geography: provides particular characteristics that could be of importance such as for example, flat or hilly terrains that can encourage or deter the use of mopeds over bicycles. Or another example can be the configuration of the street and the presence of enough bicycle lanes for commuting MCD: the more hilly the terrain is, the less successful bikesharing services will be KGBM: E-Scooters are not well suited for hills
	Streets characteristic (material/state)	KGBM; MP	
Culture	Shared mobility awareness	MP, EH	*MP:* City culture: background information on likes and dislikes of population of the city *MP:* Commuting patterns: insights on amount of people that drive to work, how many people ride the bicycles, and average commuting time and distance *MP:* Driving culture: the usage of cars related to the distance needed, the way drivers respect the rules of transit, which type of cars are most popular, etc.
	Driving culture/vehicle ownership	MP; MCT	
	Trust on mobile payment	MCT	
	Vandalism on public property	AS	
	Respecting traffic rules	MP; MCT	
	Car usage (preference)	MP	
	Motorcycle/moped usage	MP; MCT	
Infrastructure	Available infrastructure for	MCT; MHB	

	bikesharing, i.e.: bicycle lanes		MCT: cycling lanes or infrastructure can promote cycling, can increase safety, how people perceive safety and the number of women and children cycling MP: one of the key indicators for the city indexing carried out in their work was the availability of public transport in the selected cities to analyse
	Available public transport and daily usage	MP	
	Land use and density (wideness of streets/ sidewalks and parking spaces)	MP; MCT	
Climate	Seasons (temperature and rains)	MP; MCT; MHB	MP: Climate: important to know seasonal weather. Too cold weathers can discourage the use of mopeds for commuting and give preference to cars and heated public transport. Hot weather on the other hand can be a positive factor for preferring mopeds as means of transportation MCT: Monthly mean hours of sunshine also affect the demand. Warmer climate have mild decreases in daily trips during winter, as opposed to colder climates which demands shutting down the services during winter. However, the impact of seasons can be reduced by maintaining the stations and the fleet and keeping cycling roads free of snow. Cities with comfortable climates don't present these issues and are ideal for maximising bicycle usage. Windy areas can also have an impact on the bikesharing service performance.
	Wind	MP; MCT	
	Air pollution	MHB	MHB: air-pollution can discourage the use of bikesharing due to the bad quality of the air and the exercise that it implies
Market	Number, type and size of competitors	MP; MCT	*MP:* Current shared mobility providers: who are they, how long have they been in operation in the city, what kind of service they offer and, if available, vehicle and member data
	Number of existing users for shared mobility	MP; MCT	
Laws and regulations	Sustainability plans from the government	MP; SH	*MP:* Vision of the Mayor: what his or her attitude is towards integrating shared mobility services *MP:* Sustainability plan: if there is one in place, it could be an indicator of the support for shared mobility MP: Bylaws or regulations: any of which support shared mobility or plan to integrate it in the near future MCT: Helmet regulations can also be a factor to take in account when analysing the adoption of a bikesharing service *KGBM:* Regulations: the devices need to adapt to legal or regulatory requirements by local government or municipality. This could be the disposition of the lights, speed limits, mandatory helmet, and separate break handles *KGBM:* Openness of local authorities: a platform that integrates into the mobility ecosystem can provide much more value for customers. One of these examples can be seen with the e-scooter company Voi, which collaborates with Hamburger Hochbahn to supplement public transport in outer districts of the city. Cities and public transport providers usually collaborate on mobility concepts; hence the authors recommend shared mobility service provides to get in contact with municipalities early on about their business models, operations and services offers. For a mobility service provider, it would be in their best interest to have the city on their side
	Support from authorities for shared mobility	MP; MCT; KGBM	
	Helmet use requirement	MCT; KGBM; SH	
	Driving license requirement	KGBM	
	Speed limits	KGBM	
	Parking regulations	KGBM; SH	

Economy	Median household income	KSSB	*KGBM:* an advantage companies can use is using products that are already in the market and retrofitting them with their own branding and enabling technology for the shared service. Logistics and import tax are fundamental factors to consider in the business model *KGBM:* Also, business partnerships can open a new world of opportunities for a more effective penetration of the service. One of these examples is the promotion that Lime scooters has with N26 bank, where customers can get a 50% discount on every ride if they pay with an N26 card. In summary, providers need to look at the whole ecosystem and work with it, not against it
	GDP per capita	KSSB	
	Import/export regulations and taxes	KGBM	
	Available scooters in the local market	KGBM	
Technology	Public transport system integration	MCT	*MCT*: transit card integration with shared mobility solutions, as MaaS services propose, for a seamless commuting experience through a unified platform.

Table 11. Theoretical background - list of factors derived from literature review

7.7. Complete list of factors derived from experts interviews

Category	**Factor**	**Source**											**Number of mentions**
		EH	*AL*	*JG*	*AF*	*GP*	*AG*	*TC*	*MS*	*RFQ*	*SP*	*NN*	
Demographic factors	*Population*				■	■				■			3
Cultural factors	*Knowledge and perception*	■	■	■	■		■			■			6
	Vandalism					■				■		■	3
	Driving safety								■	■	■		3
	Sustainability					■		■				■	3
Infrastructural factors	*Traffic*				■					■			3
	Public transp. availability	■	■	■						■	■	■	6
	City layout	■	■	■			■			■		■	6
Climate factors	*Weather*	■	■	■			■	■				■	6
Legal factors	*Cooperation with authorities*	■	■			■	■				■	■	6
	Norms and regulations		■		■		■	■		■	■	■	7
Economic factors	*Market overview*	■	■								■	■	4
	Purchasing power		■	■								■	3
	Insurance for the fleet										■		1
Operational factors	*Communication and customer service*				■						■	■	6
	Fleet and business management	■	■	■	■		■		■	■	■		8
	Operational optimisation	■	■	■	■		■				■	■	7
	Technology and UX			■		■			■		■		4

Table 12. Complete list of factors and their number of mentions, derived from experts interviews

7.8. Moped sharing overview

Figure 6. Illustration of a moped

Mopeds belong to the micro-mobility category, which encompasses urban vehicles weighing under 500kg, and are predominantly electric (Bruce, 2018). In the case of the moped sharing, to use the service, customers use their apps on their smartphones to rent out one of the vehicles from a free-floating fleet spread across the city. Based on the information collected from personal experience with multiple providers (Coup, emmy and YEGO) from Berlin and Barcelona, this is how the service works:

Figure 7. Steps for renting moped sharing vehicles

Registration: the user needs to download the app of the provider on their smartphone and sign up to create a new user profile. The registration process is free but requires the user to submit his or her credit card details be billed at the end of each ride and a driver's licence details to enable the service. This process is usually done remotely by just uploading a picture of the licence directly to the app or by additionally verifying the documents via online video chat with an employee of the company. Once the account is verified, the user receives a confirmation and is ready to make their first ride.

Usage: most of the moped sharing operators offer the same kind of booking process. A map overview shows the location of the available mopeds and the battery level. The user selects the closest vehicle available on the map and can reserve it for 10-15 minutes without any costs, which is enough time to reach the vehicle. Once the user is next to it, it can be unlocked with the smartphone. This will give the user access to the storage box or under the seat where the helmets are stored. It is mandatory to use a helmet for security and legal reasons. For hygiene reasons, some disposable hair nets or covers for the hair can be found next to the helmets, and these avoid the user's head directly touch the interior of the helmet. Upon arrival and parking, the helmet must be stored back in the trunk and the user locks the vehicle with the smartphone.

Billing: As soon as the ride is finalised, the user must lock the moped and the cost of the ride is automatically billed to the payment method that was previously registered on the account. The user has access on their profile with all the information of all the rides and invoices he or she has been charged for.

Market analysis, customers and usage

According to (Howe & Jackobsen, 2019), the new sector moped sharing has seen its beginnings since 2012 and has been growing steadily since, with a ramp-up between 2018 and 2019. In 2019, the total population of shared mopeds grew to 60,000 units (164% more than 2018), the type of service expanded to 5 more countries, 26 new cities (42% more than 2018), 16 new operators (42% more than 2018), 3 million new registered users (166% more than 2018), and 8 new scooter manufacturers (34% more than 2018). Despite its accelerated growth in the last couple of years, moped sharing remains a niche when considering the rest of the shared mobility options. However, the Howe (2018) argues that if it is taken into consideration that the bike- and car sharing services started the same way, it is logical to assume that the moped sharing market will also move away from its niche status in the near future.

Howe & Jakobsen (2019) explain that more than 50 per cent of the moped sharing fleets are owned by 5 operators, being VOGO, eCooltra, Bounce, Cityscoot, and -up until recently- COUP the main players. Before Bounce came into the market with an explosive growth, 99 per cent of the moped sharing fleets were electric, however, this number changed as Bounce's fleet has introduced combustion mopeds and the number of electric shared vehicles has dropped to 70% (Howe & Jakobsen, 2019). Nevertheless, Bounce is making efforts to progressively transition to a fully electric fleet in line with the company's environmental sustainability goals (Devanathan, 2019). Most of the

mopeds from the total population of shared fleets reside in Europe and still presents a tendency of growth. The strongest markets in the continent are Spain, France, and Italy, being Madrid, Paris and Barcelona at the top (Howe & Jakobsen, 2019). India, on the other hand, has gained the podium of the biggest host of moped sharing vehicles, with a whopping number of 15.000 mopeds deployed as of 2019. The authors add that, although the rest of the markets account for only 12 per cent of the global shared mopeds population, it is expected that these will grow significantly. To conclude this section, figure 17 shows the worldwide growth of the shared mopeds population.

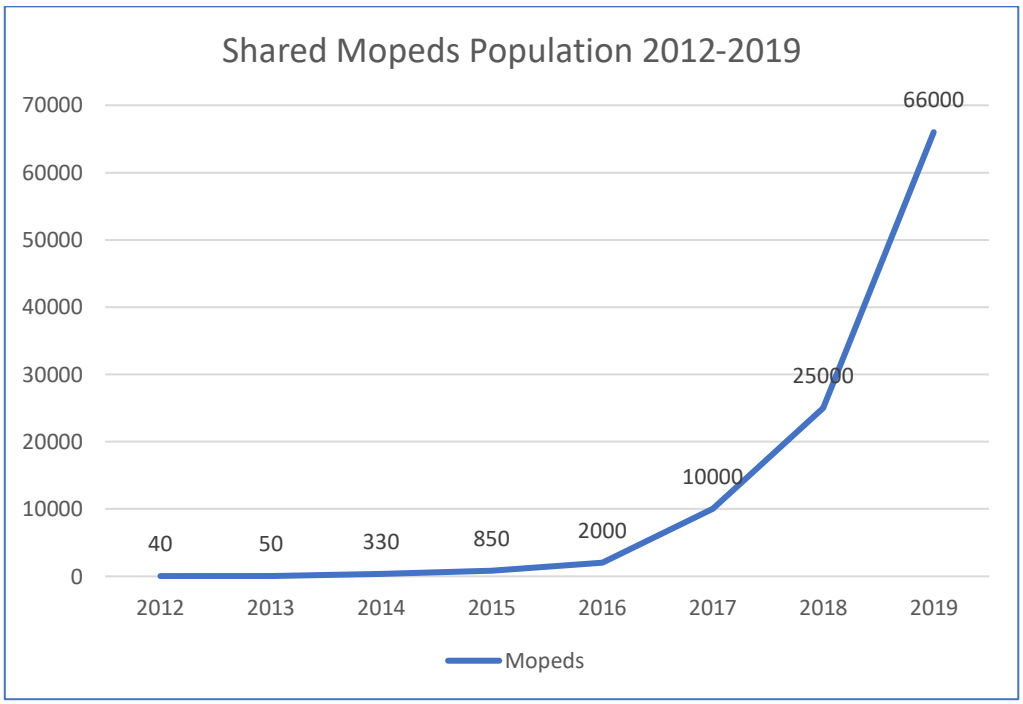

Figure 8. Evolution of moped sharing population from 2012 till 2019. Source (Howe & Jakobsen, 2019)

Investments and market expansion: Investors are gaining interest in moped sharing. Howe (2018) explains that in 2018 there has been a growth in investments in comparison to 2017. According to the author, Cityscoot received an investment for €40 million and eCooltra an investment for €10 million. Moving forward to 2019-2020, just Bounce (India) alone has managed to raise an astonishing amount of 200 million euros between venture funding and debt financing[4]. Besides, stakeholders are becoming more diverse and this combination of the volume of investment and diversity of the sources of investment is contributing to rapid market expansion. The way businesses seek to expand to new

[4] Crunchbase. Bounce. Retrieved from: https://www.crunchbase.com/organization/metro-bikes#section-funding-rounds

markets nowadays - at least in the area of mobility - has changed. In an interview with Greve (2019), he argues that the main value for attracting larger investments (mostly coming from the private sector) is focused on the customer base, and not so much on the current financial performance, especially in an industry where competition is fierce. Having a larger customer base valuates the company higher, which also means that the volume of a potential investment is higher and the interest lower. Related to this approach, businesses have migrated from a "conservative" expansion strategy approach to an expansive attitude that can be considered as bold (Greve, 2019). The expansion to new markets is usually focused on where most competition is, as there is more willing to pay due to an increased awareness of users, which makes it easier to acquire new customers. These hot markets are also where the focus of the media is, which is important for brand building (Greve, 2019).

Users: user characteristics in the moped sharing are still lacking academic research, and the information on the registered user numbers is hard to obtain, but there has been strong growth in the last years with an estimate of 4.8 million registered users (Howe & Jakobsen, 2019). The authors explain that the majority of the customers are young, especially young urban professionals. Degele, Gorr, Haas, Kormann, Krauss, Lipinski & Hertweck (2018) discovered that most of the revenue was generated by users in two categories: power users and Generation Y casual users. The power users fall around the average age of 34 whereas the Gen Y casual users average the 28 years old. Although the first group is much reduced, they account for the highest number of rentals per user and the highest frequency of usage. Howe (2018) adds that data collected from operators reveal that male users are somewhat higher than females. Duke et al. (2019) conducted a study of the usage of micro-mobility -not necessarily shared- commuters in the West Washington University campus and discovered that usage ratio of male to female was 70% to 30%. Lastly, Krümmel et al. (2019) state that the average distance per ride on a shared moped is around 9 km (although this can vary depending on the city context), and during top months, Howe & Jakobsen (2019) explain that each scooter is rented between 8 to 10 times per day, a number that is growing with each year.

Other considerations

Mopeds take up less space for parking, space that can be used to reconfigure certain parts of the urban landscape for better use. Lam (2019) cites Govecs CEO, Thomas Grübel who shares his thoughts about how shared mopeds can provide an ideal solution for urban mobility, being more efficient than any car to move around, easy to use and don't require parking. Moreover, he adds that the overall lifetime of an electric moped is between 3 to 6 years. A trend worth mentioning has to do with integrated systems. Howe (2018) explains that an increasing number of providers are not only offering one type of micro-mobility service, but they are increasing their offerings to other types of vehicles to

increase their fleet ecosystem. Howe (2018) highlights the cases of Swiss Mobility who offers both moped sharing and car sharing, Scoot in the USA who offers bike sharing, scooter sharing, and moped sharing, and ÖAMTC, the Austrian automobile and mobility association who started to offer mopeds in 2018. Overall, Howe (2018) predicts that the trend is expected to continue.