The Role of Mobility-as-a-Service (MaaS) Providers in Co-Creating Sustainable Product Life Cycles

A qualitative case study of electric vehicle rental companies in Sweden & Denmark

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Abstract

This study examines the crucial role of Mobility-as-a-Service (MaaS) providers in promoting sustainable consumption and production in the electric vehicle (EV) industry. Europe's goal of achieving zero greenhouse gas emissions by 2050, as outlined in the European Green Deal, has propelled the expansion of EVs. However, increased EV usage and associated battery production have amplified the demand for natural resources like cobalt, leading to environmental and social concerns. This study illustrates a novel approach to integrating sustainability principles into business operations, such as having MaaS providers encourage users to be involved in the rental electric vehicle's design, production and consumption rather than just merely involve users in their rental service's design, production and consumption. By exploring the role of MaaS providers in promoting a more sustainable product life cycle, this research expands the understanding of how businesses can extend their sustainability practices to include consumers. Employing a multi-case study approach, this study also identifies the challenges and benefits in co-creating practices with users.

In the finding, online platforms were most often used for rental and shared service provisions to co-creating with consumers to prompte sustainable EV life cycle. However, each of the four companies provided different insights into the design, production and consumption of the EVs. The findings of this study will provide valuable insights for EV service providers and policymakers, illuminating three co-creation spacess (co-creating design, co-creating production and co-creating consumption) as sustainable strategies for EV production and consumption. This knowledge can contribute to the change management and risk assessment literature in the field of business administration, providing practical implications for businesses considering the transition to sustainability.

Keywords: electric vehicle, use-oriented Product-Service Systems (u-PSS), co-creation spaces, co-creating design, co-creating production, co-creating consumption, life cycle, circular economy, Mobility-as-a-Service (MaaS), rental service provider

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Abbreviations

SLU	Swedish University of Agricultural Sciences
EVs	Electric vehicles
MaaS	Mobility-as-a-Service
PSS	Product-Service Systems
u-PSS	Use-oriented Product-Service Systems

1. Introduction

Promoting the extension of the product life cycle facilitates a reduction in reliance on raw materials and minimizes waste generation, which is a pivotal aspect for Mobility-as-a-Service (MaaS) providers transitioning towards a circular economy. This is the focus of this thesis. This chapter provides the background and problem statement, and further explains the objectives, research questions, and scope.

1.1 Problem background

Zero emissions of greenhouse gas by 2050 have become a future goal for Europe (European Commission, 2022). To support this objective, the European Commission introduced the European Green Deal in 2020 (European Commission, 2019). The Green Deal aims to strengthen the EU's net-zero technologies manufacturing and to develop without increasing resource usage in the context of sustainable economic growth (European Commission, 2023; European Commission, 2019). An important development to achieve this is electric vehicles (EVs), which do not emit greenhouse gases (ibid.). EVs are therefore considered to be a promising solution to the challenges of climate change and environmental pollution (Ghosh, 2020; Miao et al. 2014). In terms of electric vehicle (EV) refers to a car or other vehicle whose engine is powered by electricity rather than liquid fuel (ARENA, 2023). However, while moving away from dependence on fossil fuels, there is also a shift towards the need to extract more natural resources (RI.SE, 2022). For example, the demand for cobalt to manufacture EV batteries has increased triple in the last five years (Nygaard, 2022). With the future trend of zero CO2 emissions, it is bound to encourage relevant participants, industries, and various automakers to invest in the development of the EV industry. While EVs are seen as a solution to mitigate GHG emissions, it causes new sustainability problems e.g. the high demand for cobalt extraction. This undoubtedly poses a challenge to the relevant industries as a balance needs to be made between minimising damage to the environment and ensuring that the resources extracted are used for the benefit of society (RI.SE, 2022).

A significant aspect of achieving this balance lies in maintaining closed-loop supply chains, a critical component in reducing waste and ensuring a stable supply of

batteries (Zhao et al. 2021; RI.SE, 2022; Nygaard, 2022). As EV battery life shortens, the efficiency of mineral recovery becomes key to reusing materials and enhancing production lines. (Zhao et al. 2021; Ogunseitan, 2022). This is why it is so important to retain the raw material in the loop and extend the life cycle of the product (Nygaard, 2022). One strategy to promote resource conservation is Mobility-as-a-Service (MaaS), a model offering transportation services such as car rental and sharing without transferring vehicle ownership to the user. Figure 1 illustrates how retaining ownership encourages MaaS providers to engage in co-creation with users, thereby promoting the longevity of the product life cycle and ensuring the continuous presence of EVs within the circular economy. The MaaS refers to a service that the user can plan, and book on various types of mobility services through digital platforms (MaaS Alliance, 2022). It aims to encourage the change of the traffic habit from private cars to a more sustainable mode of mobility (ibid.). Also, MaaS reduces the sale of tangible products, thus benefiting the environment (Meier et al. 2010; Trevisan et al. 2012) and offering cost saving for businesses and consumers (Reyes et al. 2020). It is considered favourable to the environment as it promotes a shift from individual car ownership to shared transport services (ERTICO, 2019).

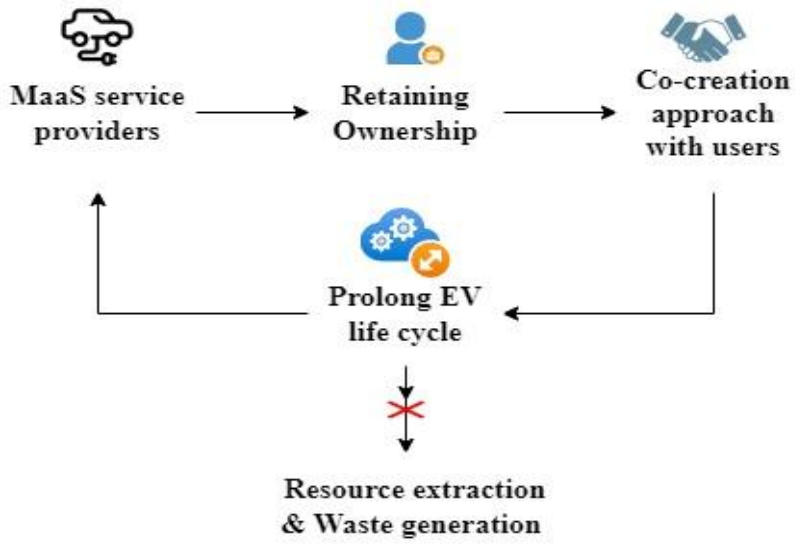

Figure 1. The life cycle of rental EVs in the circular economy.

However, EV rental and sharing services enable consumption without ownership, giving users the opportunity to lease without being responsible for the product, which may further influence consumer behaviour towards EVs (Mont, 2004). Therefore, Guo et al. (2021) suggest that the success of sustainable consumption and production under the MaaS concept depends on the willingness and ability of customers to participate in the co-creation of value. This emphasises that MaaS

providers can facilitate the impact on products due to lack of ownership and ensure the life cycle of products through a co-creation approach with users.

1.2 Empirical problem

The recent agreement by the European Parliament and Council to phase out petrol and diesel vehicle sales by 2035 and transition to EVs (European Commission, 2022) faces substantial challenges. These challenges include the social and environmental injustices associated with resource extraction, such as cobalt mining in the Democratic Republic of Congo (Nygaard, 2022; Ogunseitan, 2022). Moreover, the growing demand for cobalt and other essential metals has led to a shift towards deep-sea mining, which poses even greater risks due to limited scientific knowledge about deep-sea ecosystems (Ogunseitan, 2022), highlighting the need for circular material systems in the production and consumption of EVs (Chizaryfard et al. 2022; Nygaard, 2022).

The ongoing conflict between Ukraine and Russia has further highlighted the importance of transitioning to green electric energy (Nygarrd, 2022). The disruption of the primary route for gas exports to European countries has resulted in a shortage of oil and gas (ibid.), prompting more players in the European automotive industry to enter the EV market and increase competition (Nygaard, 2022; Keating, 2023; Velzen et al. 2019). For example, car rental company Hertz created a Green Finance Framework in 2023 to fund EV expansion and charging infrastructure projects (Sustainalytics, 2023). Their partnership with Polestar to purchase 65,000 EVs has inspired other competitors, such as Enterprise Holdings and Avis Budget Group, to follow suit (O'Leary, 2023; Mordor Intelligence, 2023). Consequently, this increased demand for EVs has also raised the demand for EVs minerals.

Among the various EV rental service approaches, Mobility-as-a-Service (MaaS) is considered beneficial for the environment as it promotes the shift from personal car ownership to shared transportation services (ERTICO, 2019). MaaS allows users to plan, book, and pay for various mobility services through a unified digital platform (MaaS Alliance, 2022). These concepts align with used-oriented Product Service Systems (u-PSS) within a circular economy framework. In a linear economy, customers purchase products and assume ownership, as well as the responsibility for maintenance and disposal. In contrast, a circular economy featuring u-PSS maintains product ownership with the service providers, who are accountable for upkeep and disposal to extend the product's life cycle (Mont 2002; Sundin et al. 2009; Reim, 2014; Kuipers, 2021). Thus, u-PSS is seen as an effective way to depend on natural resource extraction (ibid.).

EV rental and sharing service fall under the use-oriented PSS category, where service providers lease products instead of selling them, allowing consumers to access product features through a combination of tangible products and intangible services, paying for usage rather than ownership (Tukker, 2004; Kuntzky et al, 2013; Reim et al, 2015; Bore tet al. 2020). By renting, sharing, and pooling capital goods under the u-PSS concept, enterprises can reduce the number of tangible goods to be sold and reduce the environmental impact of production and consumption (Meier et al. 2010; Trevisan et al. 2012; Chen, 2020).

However, expanding their business scope into EV-sharing services presents challenges for rental companies like Sixt, Hertz, and Europcar (Invers, 2021). The lack of vehicle ownership may alter consumer usage behaviour, and vehicles in car-sharing services are often less frequently maintained and inspected, leading to difficulties in controlling the vehicle condition (Reim et al. 2015; Shaheen et al. 2018). This can result in mechanical issues and increased maintenance burdens for service providers (Chen, 2020). Furthermore, the absence of effective management and customer incentives to extend product lifecycles can also lead to shortened product lifecycles and increased waste, contradicting the sustainable consumption objectives that the u-PSS model aims to achieve (Hahn & Pinkse, 2022).

To enhance the positive influence of customers on the product life cycle under the u-PSS model, the concept of value co-creation has been proposed. Value co-creation refers to collaborative strategies that involve consumers from the beginning of product design, production and final consumption, creating value together for mutual benefit (Prahalad & Ramaswamy, 2004; Ma et al. 2019; Miao et al. 2014.). For example, digital systems provide an actual experience for the consumer and the online car rental system would not work if consumers did not actively participate in the online car rental service by matching with providers, giving ratings or providing feedback (Ma et al. 2019). Also, in terms of co-creating consumption example, EV service provision in Demank, GreenMobility communicates with users through newsletters and media channels and asks customers to drive responsibly and protect themselves to ensure the reliability of EVs and deliver them to the next customer (GreenMobility, 2021). Service providers play a key role in encouraging consumers to sustain the product lifecycle by using it responsibly and appropriately during the use phase, rather than relying solely on the service provider for maintenance (Guo et al. 2021; Tukker & Tischner, 2006). Through this collaboration, service providers can optimize their products and services to better meet the needs and preferences of their customers while promoting more sustainable consumption habits (Prahalad & Ramaswamy, 2004).

1.3 Theoretical problem

While u-PSS has been acknowledged as a vital approach to sustainable business practices, recent studies have highlighted the limitations of their actual sustainability benefits (Hahn & Pinkse, 2022). One of the reasons for this limitation is the challenge of measuring sustainability and ensuring consumer demand for sustainable products and services (ibid.). Interestingly, while service providers position themselves as eco-friendly, research points to a disconnection with users, where environmental concerns are not the principal drives of consumption (Bardhi & Eckhardt, 2012). As Botsman and Rogers (2010) suggest that sustainability might be an unintended consequence of the sharing economy, particularly as the primary motivation for car-sharing service users may not be related to sustainability goals. Despite u-PSS's potential to promote sustainable production and consumption, it also encourages consumption without ownership, which can lead to decreased user responsibility (Mont, 2004). This can, in turn, disrupt the effective implementation of the u-PSS (Hahn & Pinkse, 2022; Rexfelt & Hiort af Ornäs, 2009).

Another limitation is that many negative sustainability impacts occur during the product use phase (Reim et al, 2015), adding to the challenge of managing consumer behaviour. The current approach of implementing contractual strategies within the u-PSS model is to guide customer behaviour and reduce product risks during use (ibid.). However, Hahn et al. (2022) questioned the effectiveness of contracts and punitive means due to the difficulty in measuring sustainability, the lack of consensus on methods for measuring social and environmental impacts, and the complexity of supply chains. Additionally, consumer behaviour is hard to assess, monitor, and predict for various players in the material and product value chain, such as manufacturers, distributors, recyclers, or repairers, who are motivated by monetary rewards and legislative requirements (ParaJuly et al. 2020; Miliute-Plepiene et al. 2016; Wagner, 2013; Shevchenko et al. 2023).

Therefore, research suggests that enhanced value co-creation with users could address the absence of ownership transfer in u-PSS models, thus facilitating longer product lifecycles (Guo et al. 2021; Trevisan et al. 2012; De Koning et al. 2016). This notion of co-creation, however, remains underexplored within the leasing sector where the ownership of the product is retained by the service providers. Given the potential economic benefits tied to product longevity for EV rental and sharing companies (Guo et al. 2021), there is a compelling argument for the exploration of a co-creation process, involving users in the design and production of durable and sustainable products (Trevisan et al. 2012). Most literature on the value co-creation approach focuses on the collaboration between manufacturers and customers, such as BMW (Gilliland, 2018) or Tesla (Medium, 2022). However, the

researcher argues that MaaS providers, being at the end of the supply chain, are closest to the end customers. Encouraging customers to participate in the value co-creation process and then providing feedback to upstream manufacturers may help identify issues or experiences from a leasing perspective. This can also promote customer engagement, support for environmentally friendly practices, and even increase customer satisfaction and loyalty, leading to better care and usage of EVs. Based on this, there is a need to understand the role of MaaS providers in promoting sustainable consumption behaviours. And this area is still insufficiently studied, this research is therefore to address an important knowledge gap and provides valuable insights for future research.

1.4 Aim and research questions

The aim of this study is to create in-depth insight into the role of service providers to enable a more sustainable product life cycle for electric vehicles. The study was guided by the following questions:

RQ1: How do Mobility-as-a-Service (MaaS) providers co-create their service with users to promote a more sustainable product life cycle?

RQ2: What are the challenges and benefits for Mobility-as-a-Service (MaaS) providers to co-create more sustainable EV life cycles with users??

1.5 Scope and delimitation

The primary aim of this study is to examine deeply the role of MaaS providers in promoting more sustainable EV life cycles with users. The process of achieving the zero emissions of GHG target takes into account the social and environmental injustices that may result from increased resource extraction. This presents ongoing challenges for EV sustainability and emphasizes the necessity of maintaining a closed-loop supply chain to reduce mineral extraction and waste emissions. The research will focus on the industry of four EV rental companies—three in Sweden, namely Mabi Sverige AB, Hertz International Franchisee, and an anonymous marketing team agency, and one in Denmark, GreenMobility. The research will explore how these companies promote resource conservation with customers by integrating EV rental and sharing services. Additionally, how this model impacts consumer behaviour and the potential for co-creating value will be discussed.

Lastly, the researcher would concentrate on the sustainability and market challenges of u-PSS and explore how the value co-creation process can enhance the

effectiveness of u-PSS. This study is solely concerned with sustainability issues within the product life cycle of EVs and does not address other types of green energy or modes of transport. The researcher has not taken into account all environmental impacts, such as carbon emissions during EV manufacturing or the production and recycling issues of batteries. Furthermore, this research is confined to the Sweden and Denmark market and does not take into account the conditions in other regions. It is also limited to the relationship between consumers and service providers, without involving other stakeholders, such as government or non-government organizations. Finally, it will focus solely on the concept of the value co-creation approach in the u-PSS system, without considering other factors that might affect the product life cycle, such as technological innovation or market dynamics.

2. Literature review and conceptual framework

This chapter explores the related literature on the provision of EV rental and sharing services. The goal is to understand the current state of the research field, identify key theories, concepts, and gaps in the literature. The review will cover a broad range of topics, including the impact of use-oriented Product-Service Systems (u-PSS) on resources and waste, and business models of EV rental and sharing, consumer behavior towards EV rental and sharing, and finally, the impact of value co-creation on EVs rental and sharing services.

2.1 Literature review

The literature review would provide an overview of the service provisions' business model and the value co-creation concept. It will also explore the challenges and opportunities associated with the implementation of value co-creation from EVs service providers.

2.1.1 The concept of waste reduction and resource recovery in the use-oriented Product Service Systems (u-PSS) models

The concept of u-PSS (use-oriented Product Service Systems) underpins sustainable production and consumption. In the u-PSS model, the supplier provides both the product and the service while retaining ownership of the product. This model is designed to reduce the number of physical products sold, thereby balancing the impacts on nature and society (Trevisan et al. 2012). The value of this concept is enhanced through the evolution of knowledge and service content to compensate for a decrease in sales volume. This notion of dematerialized value significantly contributes to reducing environmental impacts and separating economic growth from energy and material consumption (ibid.). As in Figure 2. below, in the use-oriented model, ownership remains with the supplier, which encourages them to actively extend the product's life cycle (Mont 2002; Sundin et al. 2009; Reim, 2014; Kuipers, 2021). The product's life cycle can be extended

through maintenance, upgrading, and refurbishing as the product is seen as a capital asset that provides product functionality (Borg et al. 2020; Bartolomeo et al. 2003).

In comparison to a linear economy, u-PSS models focus on extending the life of products rather than allowing waste to go straight to landfills (Mont 2002; Sundin et al. 2009; Reim, 2014; Kuipers, 2021). As suggested by Bocken et al. (2016), in terms of u-PSS model, it is stressed enhancing the long-term performance of the product by slowing resource loops (e.g., prolonging usage), closing resource loops (e.g., recycling), and narrowing resource flows (e.g., improving resource efficiency). This not only reduces the amount of waste generation but also addresses the reliance on mineral extraction (Mont 2002; Sundin et al. 2009; Reim, 2014; Kuipers, 2021). This approach is, therefore, a driver to strengthening sustainable production and consumption (Mont, 2022; Chen, 2020; Nygaard, 2022). In addition, the increasing demand for raw materials from EVs such as lithium-ion batteries (Nygaard, 2022) highlights the importance of proper waste disposal and effective resource recovery. It has emphasised the importance of circular material systems in the transition to the EV industry (Chizaryfard et al. 2022; Nygaard, 2022). Because the maintenance of closed-loop systems is essential to ensure the availability of batteries for EVs (ibid.). Moreover, in this model, the intensity of product use is often increased by providing services to multiple customers (Sundin et al. 2009). Several design improvements, such as increasing the accessibility of parts for maintenance and remanufacturing, can reduce the need for maintenance, repair, and reinstallation, resulting in cost savings and potential profits for businesses (Zhao et al. 2012; Ogunseitan, 2022).

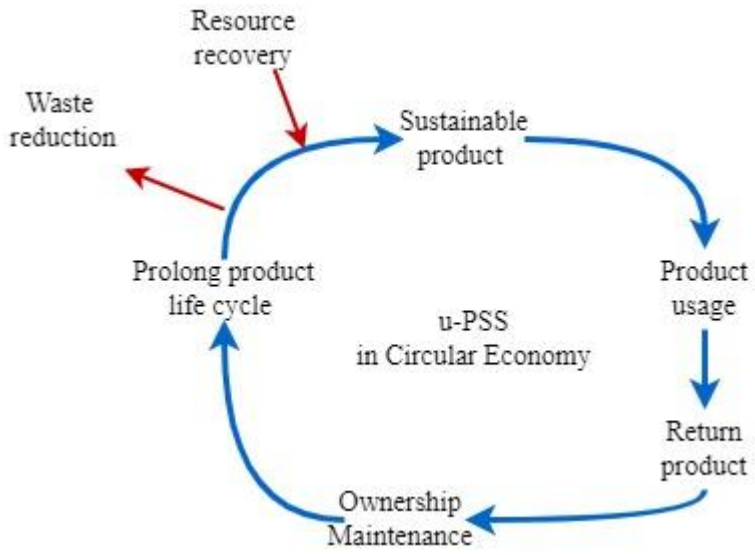

Figure 2. The closed loop of u-PSS model inspired by Quijano (2022); Life cycle initiative (2023).

2.1.2 The concept of Mobility as a Service (MaaS)

MaaS, or Mobility as a Service, is driven by constantly changing consumer attitudes, urbanization, and other social changes, such as an increased overall focus on the sharing economy (Schaefers, et al. 2015). As more and more people seek alternatives to car ownership, such as car and/or ride sharing, there is a consequent rise in demand for mobility service providers (ibid.). According to the definitation from MaaS Alliance:

> "Mobility as a Service (MaaS) integrates various forms of transport and transport-related services into a single, comprehensive, and on-demand mobility service. … To meet a customer's request, a MaaS operator hosts a diverse menu of transport options, including (but not limited to) public transport, active modes such as walking and cycling, ride/ car/bike-sharing, taxi, and car rental or lease, or a combination thereof. MaaS aims to be the best value proposition for users, societies, and the environment." (MaaS Alliance 2022)

EV service provision typically involves a company or entity that owns and operates a fleet of EVs (Hertz, 2022). The earliest record of car rental was in 1904, when a bicycle shop in Minneapolis started renting out cars (Salon, 2022). About eight years later, in 1912, a German company called Sixt began to rent cars (ibid.). After the 1950s, with a sharp increase in demand for car rentals, supply also increased, from companies like Avis, Hertz, Enterprise Rent-A-Car, and Arnold Clark Car & Van Rental. These rental companies started to expand globally, especially with the increase in travel opportunities and reduction in travel costs. By the 1970s, due to growing concern about environmental issues, public institutions and private companies began to consider the potential of EVs (Cherubini et al. 2014). From the 2000s, this issue was taken more seriously, and people had to confront the dilemma of whether to introduce an EV to the market (ibid.). Cherubini et al. (2014) pointed out that for most consumers, environmental concerns and the opportunity to save costs are the main reasons to consider alternatives to internal combustion engines.

Nowadays, car rental companies own various car brands. In addition, some companies also rent out cars, trucks, vans, and boats. With the advancement of technology, it is not necessary to go through a large amount of paperwork as before. Cars can be rented through an online app (Salon, 2022). Rental companies take the best care of their fleets. Every scratch and dent is claimed and repaired (Rentall, 2021). After keeping a car for one or two years, the rental or car-sharing companies may sell the vehicle to regular customers, or it could be repurchased by manufacturers or sold at wholesale auctions (ibid.). Rental service providers and car manufacturers often enter into buyback agreements or guaranteed depreciation arrangements (Rentall, 2021; Esenduran, 2019; Fink & Reiners, 2006). Under these agreements, rental service providers agree to sell their used fleet vehicles back to

the original manufacturer at a predetermined price after a certain period of time or when the vehicles reach a specific mileage as Figure 3.

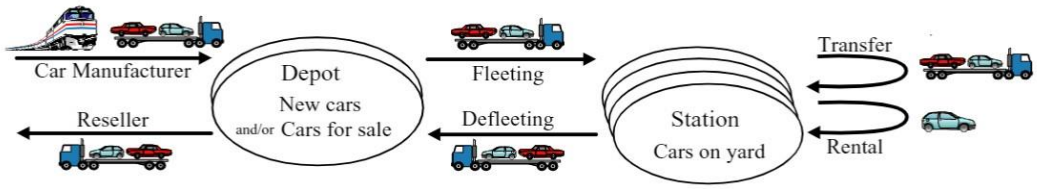

Figure 3. Car rental recycle (Fink & Reiners, 2006).

The emergence of repurchase programs is designed to avoid rental companies from directly selling a large number of used rental cars to consumers, competing directly with dealers in the sales market (Fink & Reiners, 2006). Car manufacturers introduced buyback programs to repurchase used rental cars from rental companies and redistribute them through dealers (ibid.). Over the years, Ford, General Motors, Chrysler, and Toyota USA have all launched similar buyback programs. The repurchase program from car manufacturers is generally considered financially attractive by rental companies because they can sell their used rental fleet in the short term based on market conditions (ibid.).

The concept of electric car-sharing has emerged as a promising and sustainable transportation mode (Ataç et al. 2021; Zhang et al. 2020). Car sharing can be considered as a structured form of short-term car rental, where individuals join organizations that manage a fleet of cars and light trucks spread across various locations (Shaheen et al. 1999). Members typically pay a usage fee each time they utilize a vehicle. EVs sharing services are similar to traditional car-sharing services and they use EVs which are more environmentally friendly by reducing carbon emissions and improving air quality in urban areas. Also, it provides convenient and accessible transportation options for city residents and has lower operating costs than private gasoline-powered vehicles (ibid.).

EVs sharing service providers have different business models based on the type of service offered, including business-to-consumer (B2C) and business-to-business (B2B) models, as well as the platform-based peer-to-peer (P2P) models (Nansubuga & Kowalkowski, 2021). The B2C model is particularly relevant to the present study, as it involves the service provider owning a fleet of EVs and renting them out to customers on a short-term basis (Ataç et al. 2021). Car-sharing represents a feasible measure of promoting a sustainable business model and offers an alternative to private car ownership (Ferrero et al. 2018; Reyes et al. 2020; Shaheen & Cohen, 2013). Similarly, car sharing applies to the term sharing

economy, an economy based on access rather than the ownership of material (Botsman & Rogers 2010). In other words, people rent or give assets rather than buy and own them. Car sharing encompasses multiple commercial transportation services, including truck and bus rental, e-scooter and van sharing. Unlike owning a vehicle, car sharing or rental services enable short-term car use without the financial burden and other liabilities associated with ownership (Shaheen & Cohen, 2013; Bardhi & Eckhardt, 2012; Lovelock & Gummesson, 2004).

Moreover, in the B2C electric car-sharing model, the service provider needs to own a fleet of cars, and then rent them out to customers on a short-term basis as needed (Munzel et al. 2018). As the car owner (or lessee), the service provider is responsible for car maintenance and marketing transactions (Wilhelms et al. 2017a). B2C electric car-sharing is typically usage-based, where the user pays the service provider based on the length of time (Schmöller et al. 2015). B2C car-sharing can be one-way or round-trip (Cohen & Kietzmann, 2014; Le Vine et al. 2014). Customers also have the flexibility to choose to drop off the car at a designated station within a specified area or opt for a free-floating scheme and drop off the car anywhere within a designated area (Shaheen et al. 2015). For example, in the DHL report on sharing economy logistics, Gesing (n.d.) reveals that DHL's delivery trucks do not sit idle on weekends but can be rented out to private transport companies for consumers' weekend moves, family projects and private events. It provides another incremental revenue for businesses (ibid.).

2.2 Conceptual framework

This section elaborates on the conceptual framework of the study and presents it as an analytical approach to achieve the research objectives and answer the research questions.

2.2.1 Product Service Systems (PSS) business models

The concept of a Product Service System (PSS) or Product as a Service (PaaS) refers to a product that is not sold as a physical object but as a functional outcome (Kuipers, 2021). By selling the product as a service, ownership of the product does not pass at the point of purchase (Reim et al, 2015; Chen, 2020). PSS offers several benefits to customers, including reduced environmental impact, lower costs, and increased convenience (Tukker et al. 2015). However, Hahn & Pinkse (2022) argue that PSS has sustainability benefits only if the rental product is used properly to extend the product life cycle. The PSS can be viewed as three types of perspectives below (Tukker, 2004, Reim et al, 2015)

•Product-oriented PSS, where the supplier commits to providing product-related services in addition to selling the product, and the consumer acquires both physical products and also uses service, for example, purchasing a car and obtaining a warranty and maintenance service.

•Use-oriented PSS, where the supplier does not sell a physical product but rather provides the product under a rental agreement, for example, EV rental companies.

•Outcome-oriented PSS, where the supplier agrees to provide a specific outcome to the customer, rather than a specific product or service, for example, a cleaning service.

When companies adopt a PSS implementation strategy, they integrate service or product elements into their operations in various ways. The approach taken depends on their marketing strategy and the need to improve their competitiveness (Tukker, 2004; Reim et al. 2015). According to Mont et al. (2006), the business model plays a crucial role in the successful implementation of PSS. A business model encompasses a company's logic, including how it operates and creates value for its stakeholders (Reim et al. 2014; Kuipers, 2021). By focusing on integrated, final customer needs and providing comprehensive solutions to meet these needs, companies can enhance their position in the value chain, increase the added value of their products, and boost their innovation potential (Tukker & Tischner, 2006). Therefore, the selection of an appropriate PSS business model is critical to the successful implementation of PSS. In this chapter, the discussion will primarily focus on the use-oriented PSS business model, which emphasizes meeting the needs of end-users through the delivery of comprehensive solutions.

Use-Oriented Product Service Systems (u-PSS)

Tukker and Tischner (2006) define the use-oriented product-service systems (u-PSS) as a specific type of value proposition offered by companies to meet the needs of their customers through the combination of tangible products and intangible services. The EV renal service business model (Table 1) highlights the importance of a value proposition as the core component of a successful business model. This proposition refers to the bundle of benefits which could contain the products and services offered to its customers (Zott & Amit 2010; Calstart, 2012; Reim et al. 2015; Zott & Amit, 2010). The value delivery focus on the service provider’s capabilities, including reliable and well-maintained vehicles (Reim et al, 2015; Chen, 2020). Additionally, revenue streams and cost structure are crucial aspects of value capture, which involves generating revenue through pricing models such as pay-per-use or subscription-based plans and managing costs associated with

providing the service, such as vehicle maintenance, marketing, and personnel (Reim et al, 2015). Meanwhile, in this u-PSS model, the value delivery corresponds to the business strategy stated by Bocken et al. (2015) of slowing loops, such as extending product value, and closing loops, such as extending resource value. This strategy emphasizes the importance of designing PSS models that minimize waste, optimize resource utilization, and create value for all stakeholders (ibid.).

Table 1. u-PSS business models (D'Amato et al. 2020; Calstart, 2012; Turon, 2022; Tukker et al. 2015;Reim et al, 2015; Chen, 2020).

Value Proposition	- Maximizing fuel displacement, - Cost reducing Reducing purchase price, No maintenance or insurance costs - Minimizing infrastructure installation costs - Accessibility and convenience
Value Delivery	- Maintenance, - Durable product, - Re-design / recycle / reuse
Value Capture	- Cost structure Platform maintenance Fleet maintenance Insurance, personal cost marketing and management costs - Revenue steams Rule-braking charges, Pay-per-use Subscription-based plans

In summary, through the u-PSS car-sharing model, firms could facilitate strengthening performance services, extend product life cycle, and achieve decoupling economic growth from resource consumption (Batlles-delaFuente et al, 2021; Chen, 2020; Cohen & Kietzmann, 2014). u-PSS can increase the refuse and recycling of end-of-life products and increase resource productivity (ibid.). For service providers, the longer a product lasts, the better. By designing products to reduce maintenance costs and extend service life, the total cost of ownership is reduced and a higher value proposition is created (Kuipers, 2021). Compared to traditional business models, u-PSS build a closer relationship with the customer and stakeholders within the supply chain (Beuren et al. 2013; Reim et al. 2015). Customer involvement no longer takes place only during the transaction and after-

sales services but becomes a continuous process helping firms to have more insight into customer behaviours (Hahn & Pinkse, 2022).

2.2.2 The concept of value co-creation

> "... Leaders now need a new frame of reference for value creation. The answer, we believe, lies in a premise centered on co-creation of unique value with customers. It begins by recoginzing that the role of the consumer in the industrial system has changed from isolated to connected, from unaware to informed, from passive to active." (Prahalad & Ramaswamy 2004:1)

In the modern digital era, the ubiquity of the internet allows consumers to access copious amounts of information without geographical constraints, enabling them to evaluate product performance, price, and quality more effectively. This dynamic has significantly altered the traditional approach companies used to take, where they autonomously designed products, controlled production processes, and managed marketing communications and sales channels without direct consumer involvement (Prahalad & Ramaswamy, 2004). The change is largely driven by consumers' ability to access a plethora of online information, along with their increasing tendency to share their product usage experiences and provide feedback digitally, such as knowledge sharing on Youtube or Facebook. This consumer behaviour has led to a shift away from the traditional top-down marketing communication model (ibid.). This shift prompted Prahalad and Ramaswamy (2004) to introduce the concept of value co-creation, a collaborative approach that engages customers, leveraging shared knowledge and experiences to better understand and meet their needs. This strategy is particularly beneficial when engaging experienced customers who can contribute substantially to the creation of services (Auh et al. 2007). Furthermore, this co-creation paradigm is a key driver of business innovation within organisations (Alves et al. 2016).

Value co-creation in a service system primarily emerges from interaction and personalisation of the customer experience. This approach involves direct and indirect interactions throughout the life cycle of a product-service solution with users (Grönroos & Voima, 2013). For example, the exchange of information can foster business relationships between service providers and consumers, enabling contract agreements, service adjustments based on customer needs, and the establishment of cooperative norms that foster unity (Saccani et al. 2014). As such, Trevisan et al. (2012) argue that service-dominant logic should prioritise fulfilling end-user needs over merely focusing on outcomes, given that rental service providers' revenue is closely tied to customer satisfaction. As customer satisfaction increases as indicated by their participation level, attitude, and behaviour so does loyalty, ultimately mitigating negative behaviour (Auh et al. 2007). Furthermore, Kaaronen (2017) asserts that consumer interaction with a product during use is a

determining factor in achieving environmental benefits. In real-life scenarios, each consumer may use sustainable products differently (Pucillo & Cascini, 2014), adjusting their behaviour to maximise a product's eco-friendly features, or possibly overlooking these aspects altogether.

From the perspective of companies, co-creation allows them and their suppliers to gain a deeper understanding of consumers, acquire fresh ideas for design, engineering, and manufacturing, and gain further insights into consumer motivations, behaviours, and the trade-offs involved in recognising product features and functions. By engaging in ongoing dialogue, companies can diminish uncertainties associated with capital investment and identify and alleviate potential environmental risks. This approach sets the stage for collaborating with customers to formulate value propositions that are mutually beneficial (Vargo & Lusch, 2010). Nevertheless, co-creation with customers presents certain challenges. It is a time-consuming process and raises issues such as determining the extent to which different customers should contribute to product design and managing the risk of exposing sensitive company information (Prahalad & Ramaswamy, 2004). In addition, Mael et al. (2014) highlight that customers' reactive behaviour to the design, production, and delivery of specific goals encompassing both independent customer efforts and interactive behaviour between customers and businesses combined with other knowledge types, can create value over an extended period.

2.2.3 The relationship between u-PSS and value co-creation

The concept of u-PSS entails providing products and services while retaining ownership of the product (Mont 2002; Sundin et al. 2009). That is, under this model, businesses' pursuit of profit does not necessarily rely on exchanges of physical trade, but rather, it is through the provision of services to meet consumer needs, with the product serving as one of the components during the transaction (Trevisan et al. 2012). Additionally, Meier et al. (2010) suggest that the rental, sharing, and pooling of capital goods under a u-PSS model can result in positive environmental impacts and encourage producers to take on responsibility. In traditional business models, value is viewed as embedded within the product and is determined by its exchangeable monetary value (Mont 2002). However, under service-dominant logic, the concept of value is no longer tied to a physical product but is associated with the use of a series of products and services (Mont, 2022 & Reim, 2014). Under this model, users must interact with the product or service to generate value. Value is perceived to be created during the process of the activity (Trevisan et al. 2012; Ma et al. 2019). The value of the service is determined by customer satisfaction, and customers are viewed as creators of value through their experiences with the product or service. (Trevisan et al. 2012).

Thus, the role of the provider is to facilitate this value co-creation approach. The provider's revenue is also dependent on customer satisfaction, emphasizing the importance of strengthening the value proposition. This is a key consideration in designing products or services.

As Shostack (1982) and Vandermerwe (2000) suggest, value co-creation can occur at various stages of the customer journey. They argue that providers must have a holistic view of necessary activities within the service delivery process, starting from designing customer services, such as the upfront value proposition, the mid-process of how to provide benefits (value delivery), and the later stages of value creation. The design of the service delivery and usage along with the customer plays a crucial role because this is when capital goods can be intensively managed and shared, leased, or pooled, thereby generating significant environmental benefits (Meier et al. 2010). Value co-creation originates from the participatory process between suppliers and customers, where they mutually benefit (Trevisan et al. 2012; Ma et al. 2019). This means that suppliers can extract value from customers, such as new knowledge, and customers perceive more value or achieve greater satisfaction in use (Trevisan et al. 2012). As an example cited by Trevisan et al (2012) a clothing rental company enhanced its understanding of customer usage by communicating and exchanging experiences with customers, which improved their knowledge about the ways clothes are used or worn out. This led to the redesign of new work clothes using more durable synthetic materials, thus improving their product. While retaining product ownership, the economic interest of suppliers lies in extending the product's life cycle, explaining why co-designing and producing with customers can lead to the invention of more durable and sustainable products (ibid.).

Moreover, Porter & Kramer (2011) point out that by establishing shared value, companies can share their sustainability efforts with customers. By emphasizing that long-term usage of rental cars can reduce resource consumption and environmental pollution, customers may be more willing to extend their lease period, recognizing it as environmentally responsible behaviour (ibid.). Whether at the product or service design and production stages, the approach can encourage customer participation in the co-creation process, and then feedback to upstream manufacturers may provide issues or experiences generated from a rental perspective. This could not only improve the quality of the service or product and strengthen the value proposition but also enhance the customer's sense of participation and support for environmentally friendly initiatives. Even improving customer satisfaction and loyalty can increase customers' acceptance of EVs.

2.2.4 Framework for analysing the role of MaaS in co-creating sustainable product life cycles

Based on previous research, MaaS providers play a crucial role in extending the EVs' life cycle. However, as cooperation with users is essential for rental service providers to achieve this goal, it suggests that the product life cycle is co-created by multiple actors. It is not only the manufacturer, the rental service provider or the user who is responsible for ensuring a sustainable EV life cycle. In the u-PSS model, rental service providers are the owners of EVs and thus play a key role. How service providers co-create the product lifecycle with users is therefore an important area of research, as the management of product lifecycles impacts the environmental performance of EV production and consumption.

In this case, the provider's EVs are the tangible commodity and the services they offer are the intangible commodity. The potential role of EV rental and sharing companies could catalyse a sustainable EV life cycle with users in the circular system. To investigate the role of MaaS providers, the researcher employs the business model framework, which is illustrated in Figure 4 below. In the left-hand side of the figure, the business model framework considers the value proposition, value delivery, and value capture, which helps to understand the role of MaaS providers in this industry and how they structure their business models. Since the business model is integrated with users of the EVs, the framework also considers the space of co-creating sustainable products life cycle with users which shows on the right-hand side of the figure. As the researcher is unable to observe the process of co-creation with the rental service providers and customers, the researcher would use the three co-creation spaces to collect data to examine how MaaS providers use the co-creation approach with their users to extend the product life cycle. Thus, based on the concept of co-creation spaces, the analytical categories are divided into three spaces: co-creating design, co-creating production, and co-creating consumption. In the middle of Figure 4, the MaaS provider is the key focus and it is considered a crucial actor to facilitate the co-creation with users in their services.

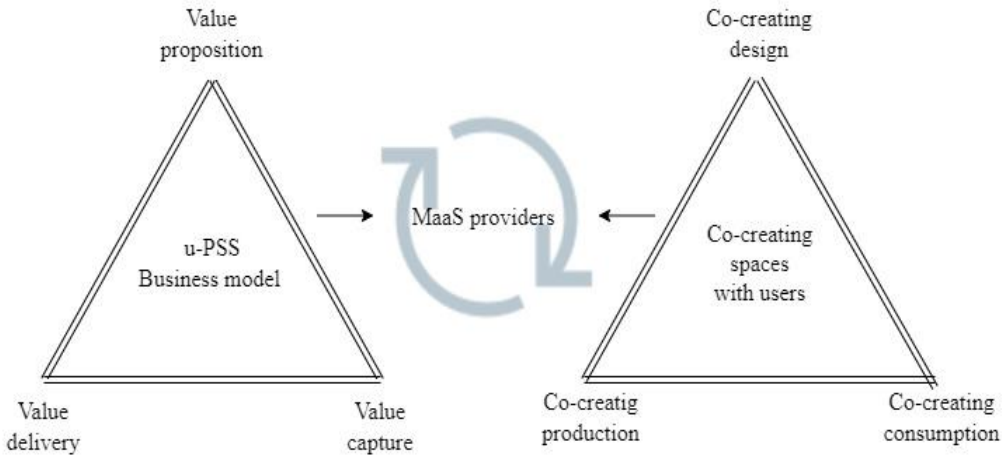

Figure 4. Framework for analysiing the role of MaaS providers in co-creating spaces with users (own illustration).

The business model framework combined with the three analytical themes of co-creation has guided data collection and analysis to address the following two research questions:

- Research question 1: How do mobility-as-a-service providers co-create their service with users to promote more sustainable produce life cycle?

To address this question, the MaaS business model is analysed first. Then, the space of co-creating design is analysed to gain insights how service providers promote user-centred design by involving users in the design space of EV rental and sharing services. Secondly, in the space of co-creating production, an analysis of how service providers involve customers in the production space to achieve sustainable practices. Finally, in terms of co-creating consumption, an analysis of how co-consumption practices encourage collaborative consumption and responsible user behaviour.

- Research question 2: What are the challenges and benefits for service providers to co-create more sustainable life cycles with users?

To address this question, the challenges and benefict of adoping the co-creation spaces is analyzed to inform future research.

3. Methodology

This chapter introduces and describes the methodological choices based on ontology, epistemology and axiology to present the authors' research philosophy. The chapter begins with an introduction to the research philosophy and paradigm, followed by a qualitative research design and a literature review. The selection of cases then illustrates the motivation for data collection and analysis. Finally, the chapter presents the quality criteria and ethical considerations of this thesis.

3.1 Research philosophy and paradigm

According to Bell et al. (2019), research philosophy and paradigm are crucial components in defining the overall research design and methodology. Saunders et al. (2012) state that research philosophy reflects the researcher's beliefs, values, and assumptions, while the research paradigm determines the overall approach of the research process. In the field of business and administration, the research philosophy consists of ontology and epistemology, which outline the researcher's stance (Bell et al. 2019). Bell et al. (2019) indicate that ontology includes two perspectives, objectivism and constructivism, while epistemology consists of positivism and interpretivism. Additionally, Saunders et al. (2012) include another element, axiology, which refers to the researcher's views on the role of values in research.

For this study, the research paradigm is a combination of constructivism, interpretivism, and realism axiology. Firstly, the constructivist perspective suggests that reality is socially constructed through human perceptions, interpretations, and experiences (Bell et al. 2019). In this case, the service providers' efforts to promote sustainable behaviours among consumers can be seen as a socially constructed phenomenon. This perspective is particularly relevant to this study as it acknowledges the subjective nature of consumer behaviour and the importance of understanding their motivations and perceptions. On the contrary, the perspective of ontological objectivism means the nature of reality is objective and factual, and not dependent on human's subjective interpretation or perspective (ibid.). Since this philosophical stance highlights the role of social and cultural factors in shaping our

understanding of reality, the framework of ontological constructionism would be more relevant to the study.

In terms of epistemology, this study adopts an interpretive perspective. The foundation of interpretivism emphasizes the importance of interpretation and understanding in social research. It suggests that social phenomena are complex and cannot be reduced to simple cause-and-effect relationships (ibid.). Although epistemological positivism suggests that knowledge can only be considered valid if it can be objectively observed and measured (ibid.), it is challenging to adopt this perspective in this study as personal experience and education may influence the researcher's interpretation. For example, in this study, the researchers used semi-structured interviews, and whether the interviewees' answers were objective and the researchers' interpretations were also affected by personal education and experience. Similarly, an axiological realist standpoint emphasizes that researchers may be influenced by their worldview, cultural experience, and upbringing (Saunders et al. 2012).

In summary, the research philosophy adopted for this study is based on a constructivist ontology, interpretivist epistemology, and realist axiology. These approaches are appropriate for investigating the challenges faced by car-sharing and rental service providers in prolonging the life of vehicles and how value co-creation has been deployed as a market strategy to motivate users to take care of the vehicles. This also aligns with Tukker and Tischner's (2006) view that constructivist ontology focuses on the essence of reality and the existence of an objective reality that can be studied through empirical research.

3.1.1 Abductive approach

This study employs an abductive research design, which involves a dynamic interplay between inductive and deductive reasoning (Bryman, 2012). This approach is particularly suited for the research objective aimed at understanding the phenomenon of how service provisions encourage sustainable usage through value co-creation. The study establishes a theoretical framework (i.e., value co-creation spaces and u-PSS business model) and seeks to apply and further understand this theory in a new context (EV rental and sharing services). This resembles the deductive approach, which begins with a hypothesis derived from theory and then tests it (Bell, et al. 2019). However, the problem arises when the researcher is unclear about which theory to test. If inductive reasoning is used, it is discovered that there is not much empirical data to build a theory. Thus, the researcher opts for abductive reasoning. The abductive research design allows moving back and forth between empirical evidence and literature (Bryman, 2012; Bell et al. 2019), which aligns with this study's attempt to understand how the theoretical structure (value

co-creation spaces and u-PSS business model) develops in a specific context (EV rental and sharing services). This strategy permits the integration of unexpected findings and iterative adjustments into the research process, which is crucial for the exploratory and innovative nature of this study (Bell et al. 2019). As Bell et al. (2019) mentioned, when researchers encounter empirical phenomena that existing theories cannot explain, confusion may arise. Abductive reasoning involves seeking to identify the conditions that make the phenomenon less perplexing, turning surprising facts into matters of course (ibid.).

3.2 Qualitative research design

Quantitative and qualitative research represent distinct research strategies. Quantitative research emphasizes the quantification of data collection and analysis, focusing on the testing of theories (Bell et al. 2019). It tends to adopt the models and practices of natural science, viewing social reality as an external, objective reality (ibid.). In contrast, qualitative research focuses on the use of text and imagery and emphasizes theory generation from empirical research (ibid.). It leans towards stressing how individuals interpret their social world and perceives social reality as a constantly changing and emerging creation of individuals (Bell et al. 2019). According to Saunders et al. (2012), qualitative research can deeply explore and understand complex social phenomena. In service provision contexts, consumer behaviour during the usage phase is influenced due to service providers retaining ownership of the vehicles (Reim et al. 2015; Trevisan et al. 2012; Bartolomeo et al. 2003). As argued by Miliute-Plepiene et al. (2016), Wagner (2013), and Shevchenko et al. (2023), service providers also face challenges in predicting and monitoring complex consumer behaviours. Quantitative research may not provide a complete understanding of these complex phenomena (Merriam, 2009), as it may overlook key qualitative aspects of human behaviour (Bryman, 2012). Furthermore, qualitative research is often used to generate new theories or hypotheses, rather than testing pre-existing theories or hypotheses like quantitative research (Bell et al. 2019; Saunders et al. 2012).

Based on some qualitative research, the perspectives of the research subjects serve as the empirical starting point, many scholars argue that the type of reasoning involved should be described as abductive rather than deductive (e.g., N. Blaikie 2004a; Charmaz 2006; Bryman, 2012). In abductive reasoning, researchers ground their theoretical understanding of the contexts and people they are studying in the language, meanings, and perspectives that form their worldview (ibid.). Therefore, to better understand how car rental and sharing companies perceive value co-creation and how they implement it in practice, this study will employ qualitative interviews and use abductive reasoning to establish a theory. It will explain, based

on the interviewees' perspectives, why car rental or sharing companies have or have not integrated value co-creation spaces into their business models. This approach contrasts with using deductive reasoning, which assumes that value co-creation strategies are essential for a company's success, or inductive reasoning, which forms a new theory based on data collected from interviews or observations.

3.2.1 Multiple case study

This study employs a multi-case research design, with each company operating within the same domain yet exhibiting differing activities (Bell et al. 2019). A comparative design is also incorporated, as multi-case research primarily serves the purpose of contrasting the cases involved. Therefore, by comparing two or more cases, researchers can recognize situations in which a theory holds in real life. This is because researchers will be able to examine the operation of generative causal mechanisms in contrasting or similar contexts (Bryman, 2012). For instance, through the application of a multi-case study, car rental and sharing companies utilize value co-creation (cause), encouraging customers to make efficient use and extend the life cycle of vehicles (direct result), thus demonstrating the utility of sustainable consumption and production (ultimate outcome). However, Bryman (2012) also cautions that such causal relationships may not be the sole influencers of behaviour; other environmental, organizational, or individual factors could also be at play. The focus of this study lies on the cases and their unique contexts, unlike a cross-sectional design that targets general survey results while scarcely considering the unique context of each case (Bell et al. 2019). Moreover, through the comparative design, researchers can contrast and compare findings drawn from each of the four cases. This approach also allows researchers to consider the unique and common elements within cases, often bringing up theoretical reflections on the survey results (ibid.).

3.3 Literature review and research

A literature review provides the foundation and direction for a study, illustrating the current phenomena related to the research topic (Bell et al. 2019). The review serves to justify why your study adopts the specific design and approach it does, using the existing literature to provide a solid rationale for your research (ibid.). It also involves drawing upon and reconfiguring existing literature to build an understanding that fits your research content. In order to establish an understanding of the research field, a narrative literature review was conducted. This approach was chosen because the study aims to understand the strategies used for value co-creation within a specific context. A broad overview of the topic is needed, drawing on different perspectives. A narrative literature review, in comparison to the

systematic literature review, allows for a more expansive exploration of theoretical concepts, methodologies, and findings from various studies (ibid.). The primary sources of literature were Google and Google Scholar, with additional information collected from organizational websites and secondary data. Some articles were also accessed through the Primo database of the Swedish University of Agricultural Sciences Library. The search terms used in this study included "car rental," "sharing service," "provisions," "value co-creation," "PSS," "business model," "business management," and "sustainable development."

3.4 Data collection and analysis

The following semi-structured interviews would used to collect data from four interviewees and to provide analysis and conclusions for this study.

3.4.1 Semi-structured interviews

This interview will use semi-structured interviews to collect data for the case study. In a semi-structured interview when the question is asked, the researcher can decide to continue the conversation or continue the next question based on the respondent's answer (as Appendix 1). Bryman and Bell (2015) indicate that semi-structured interviews allow the researchers to remain open to what they need to know. And then through the conversation, researchers might discover new insights; as a result, it not only allows researchers to find out what concepts or theories are needed from the data but also to complement or enhance what the researchers have not thought about yet. All interviews will record with the agreement of the interviewees, as it is difficult to remember all the conversations (Saunders et al. 2012). After the interview, the audio files will transcribe into text and the audio files recorded. This method of recording and transcribing allows for more in-depth analysis as the data can be repeated to check (ibid.) The use of semi-structured interviews will enable the researchers to gain detailed insights into the challenges faced by the service providers in extending the life cycle of its vehicles and the value co-creation strategies adopted to incentivize users to care for the vehicles during usage.

3.4.2 Respondents

The list of interviewees is shown in Table 2. After confirming online, the relevance of the interviewees to the research, the author contacted them via email. The criteria for selecting participants included: car rental and sharing companies operating in Sweden or Denmark with a product portfolio that includes EVs, and targeting positions related to marketing or sustainability management in order to understand their sustainability marketing strategies. In the email, the purpose of the research was described, and a proposal for an interview with the participants was put

forward. If the interviewee was interested, the date, time, and type of the interview would be determined via email. Before formally recording the interview, first got permission to record and informed interviewees that the material would be used for academic purposes. Transcriptions have been organized and confirmed by the interviewees.

Table 2. List of interviewees.

Service provision	MABI Sverige AB	GreenMobility A/S	Hertz International Franchise	Anonymous
Position	Procurement officer & environmental manager	Head of marketing	Chief marketing Officer	Marketing agency officer
Interviewee	Anders Hollbrink	Lars Østergaard	Anders Tärnell	Anonymous
Interview Date	2023/4/28	2023/4/27	2023/4/21	2023/4/17
Business Area	Sweden	Demark	Sweden	Sweden
Interview Duration	35mins	30mins	30mins	30mins
Interview Type	Online interview	Online interview	Online interview	Face-to-face interview

3.4.3 Data analysis - Coding

Thematic analysis is a qualitative method used to identify, organize, and gain insights into patterns and meanings of themes within data (Clarke & Braun, 2017). Thematic analysis assists reachers in capturing interesting potential characteristics of data related to the research questions by generating codes and themes from qualitative data (ibid). Researchers first convert audio files into text files, repeatedly read and familiarize themselves with the transcripts, and ensure that the transcribed text accurately reflects the original audio recordings. During the reading process, summaries or insights are recorded. The second step is to begin coding, with the unit of analysis of rental and sharing service providers and unit of observation of the respondents (e.g. marketing managers) in the space of value co-creation with users in EV rental companies, as shown in Figure 5 below. While some coding categories are predetermined, the coding is not fixed and may derive from the interviewees' responses. Researchers find that some data may correspond to or not correspond to several established themes. Thus, while categorizing and interpreting data, adjustments are made iteratively based on how they contribute to achieving the research objectives and answering the research questions.

Additionally, researchers identify and assign labels to words or phrases from the data that represent important or recurring themes. These labels can be words or phrases that are easy to remember, navigate, and organize. Common themes and

concepts are identified from the coding to label information, and then differences between the four companies are derived from these common themes. Subsequently, the analysis themes are abductive. Moreover, the four interviewees would share their knowledge and experiences of how they collaborated with consumers in the service and product planning process. Thus, the four interviewees would be the unit of observation and the service providers would be the unit of analysis, which is the focus of discussion within this study. Finally, in the reporting stage, the collected data is categorized according to the theme classifications in the abductive method. This is achieved through iterative cycles between data and theory, and by comparing the findings with previous empirical research and theoretical frameworks (Linneberg & Korsgaard, 2019).

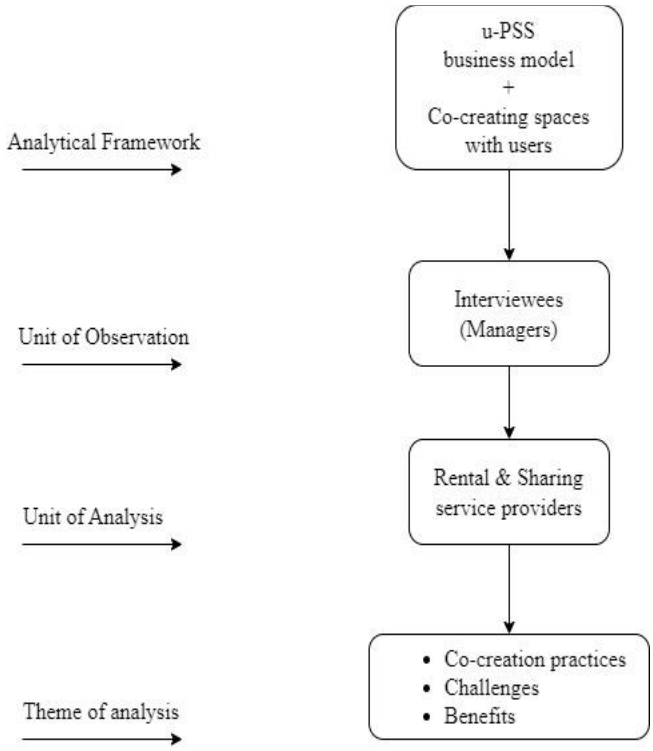

Figure 5. Hierarchical coding frame.

3.5 Unit of analysis and observation

According to Sheppard (2020), the unit of analysis refers to the main focus of the study, the entity that researchers want to make conclusions about. On the other hand, the unit of observation is what researchers actually observe, measure, or collect to gain insights about the unit of analysis (ibid.). In this research, the value co-creation spaces is conceptualized as an interactive and mutually beneficial social process involving both service providers and customers (Trevisan et al. 2012; Ma et al. 2019). By examining the co-creation spaces, the study aims to understand

how service providers collaborate with users in the design, production, and consumption of EV-related services. Specifically, it focuses on the strategies, motivations, and challenges faced by service providers in facilitating a sustainable product life cycle for EVs through co-creation with users. Accordingly, the service providers would be the unit of analysis and the interviewees would be the unit of observation in this study. While the study acknowledges the importance of users' preferences, attitudes, and feedback in shaping the co-creation spaces, the primary emphasis is on the role of service providers in driving sustainability. It examines the actions and initiatives taken by service providers to actively engage users in the co-creation process, ultimately contributing to a more sustainable product life cycle for EVs.

3.6 Quality criteria and ethical consideration

Compared to the three quality criteria of reliability, replicability, and validity in quantitative research, Lincoln and Guba (1985) argue that qualitative research requires an additional criterion of confirmability to increase the trustworthiness in the research. That is credibility, transferability, dependability and confirmability (Bell et al. 2019). By adhering to these standards, researchers can examine whether their research is relevant, accurate, and trustworthy, and can contribute to a certain extent to the current knowledge of the field.

3.6.1 Credibility

Credibility is crucial for ensuring the accuracy and reliability of research findings (Bryman & Bell, 2011). This criterion is related to internal validity in quantitative research (Shenton 2004; Bell et al, 2019). In order to enhance the credibility of qualitative research, relevant sources are cited to support the claims made. In addition, the researchers conducted semi-structured interviews with a consultant company for electric car rental in Sweden, as well as one electric car sharing and one rental company respectively in Sweden and Denmark, to obtain a credible sample of data. The use of semi-structured interviews in this study allows for triangulation by asking the same question in different ways or cross-checking answers (Bell et al, 2019). The interviewees were all in marketing or sustainability-related positions with over 20 years of experience, providing reliable insights for the research. By linking the literature review with research questions, findings, and discussions, researchers can gain a deeper understanding of the topic and compare the knowledge gained from the study (Bell et al. 2019). These checks were used to confirm the data and increase credibility. Furthermore, peer review can provide constructive criticism to challenge the researcher's views and increase credibility (Shenton, 2004), and there have been two peer reviews conducted so far.

3.6.2 Transferability

Transferability refers to the degree that research findings can be applied to other contexts or situations outside of the specific research environment (Lincoln & Guba, 1985). This criterion is similar to external validity in quantitative research (Shenton, 2004; Bell et al. 2019). In the context of EV rental and sharing services, transferability can be judged by providing a detailed description of the research methods used and reflecting on the limitations of the selected methods to allow readers to assess the degree of transferability. According to Shenton (2004), transferability in qualitative research refers to whether the research findings have wider applicability and relevance. However, there are limitations in qualitative research due to the use of limited samples. Although this study cannot claim universality due to the small sample size and geographical selection limited to Sweden and Denmark, it can be claimed that it is applicable to the sharing and rental industry in other European regions.

3.6.3 Dependability

Dependability refers to the consistency and repeatability of the research method used. It ensures that the research can be replicated by others and produce consistent results (Bell et al. 2019). This standard is equivalent to reliability in quantitative research (Shenton, 2004; Bell et al. 2019). This research would use triangulation to collect data from secondary sources, literature reviews, and interviews to improve reliability standards. Before conducting semi-structured interviews, copies of the interview guide were provided to all participants in the data collection process. Although the interviewer's preparation beforehand may influence the interview results and provide ideal answers rather than actual truthful answers. However, Bell et al. (2019) argue that copies of the interview guide (Appendix 1) can enhance the reliability of semi-structured interviews, ensuring that interviewees can understand and answer questions correctly in the research context. Also, respondent validation was also used, where the researcher summarized the interview content for interviewees for accuracy, checking for any answers that needed to be changed or further explained to enhance reliability. Additionally, the researcher's knowledge about the EV sharing and rental industry during the limited research time can also affect the dependability.

3.6.4 Confirmability

Verifiability refers to the extent to which research results are based on neutral data collection that is not influenced by the researcher's biases or preconceptions, ensuring that the research findings are trustworthy and reliable (Bell et al. 2019). For the EV rental and sharing services industry, researchers may be influenced when analyzing data from individual interviews, user comments and feedback on

social media, and other sources. As suggested by Saunders et al. (2012) in the Axiology of Realism. It can be difficult for researchers to remain impartial and unbiased. However, the authors acknowledge that achieving complete objectivity is an impossible task and requirement. Nevertheless, personal opinions need to be minimized as much as possible and managed through reflexivity (Shenton 2004).

3.6.5 Ethical consideration

In the context of research, ethics is the adequacy of your behaviour in relation to those who become your subjects or are influenced by your work (Saunders et al. 2012). In this qualitative research, interviewees are all voluntary participants, whether it is online or face-to-face interviews, recording only takes place with the interviewee's consent (Bell et al. 2019). After transcription, the materials are sorted and checked with the interviewee to confirm what data can be made public and what cannot. Each research participant will be individually confirmed on whether to use anonymous or real names. Although anonymity is generally considered the best ethical choice, some research participants may feel that retaining their real names is important to recognition of their participation in the research project (Grinyer, 2002). When analyzing data, the researcher will avoid taking sides with participants and try to avoid disclosing only positive or negative results. The research will report multiple perspectives and opposite findings as much as possible (Creswell, 2013).

Responding appropriately to the time spent and effort that participants have put into our project is important for mutual benefit. Research would report what the participants have gained from our research and share the actual results with them (Cresswell, 2013), as their participation is crucial to data collection. Furthermore, it is important for researchers to establish and maintain trust with research participants throughout the research process. This involves being transparent about the research aims and methods, respecting the privacy and confidentiality of participants, and ensuring that participants are aware of their rights and the potential risks and benefits of their involvement in the study (Saunders et al. 2012). Overall, ethical considerations are an essential component of any research project, and researchers need to be mindful of the potential impact of their actions on participants. By adhering to ethical principles and guidelines, researchers can help to ensure that their work is conducted in a responsible and respectful manner and that the rights and well-being of all involved are protected.

4. Empirical findings

This chapter introduces the empirical data collected through semi-structured interviews. The background of the four MaaS providers would be introduced respectively first, followed by data results about implementing the value co-creation spacess. Lastly, it would show the comparison of the ideal sustainable product life cycle and empirical findings in the EV rental industry.

4.1 MABI Sverige AB

MABI Sverige AB, a subsidiary of Hedin Group, is one of the largest private car rental companies in Sweden (Mabi Sverige AB, N.D.). Established in Stockholm in 1989, the company has representation in 150 locations nationwide and operates a fleet of 4,000 vehicles (ibid.). Its main business areas include MABI Rental Cars for car rentals, MABI Mobility for carpooling, MABI Truck Rental for heavy trucks, and Flexilease, which offers leasing services specifically for businesses. It provides consumers with flexible vehicle choices such as diesel, gasoline, plug-in hybrid and EVs. In terms of sustainable development, MABI Sverige AB is committed to continuously improving its processes such as offering sustainable transportation and car sharing. The company also facilitated the responsible handling of all chemicals and waste and minimised water and energy consumption (ibid.). By the end of 2022, the number of their rental days approached one million, representing a 23% increase compared to 2021 (ibid.). Meanwhile, the industry experienced a 12.2% growth in rental days. One of the factors contributing to the company's success is its high fleet utilization rate. Due to environmental concerns and traffic congestion, MABI Sverige AB aims to achieve a 70% utilization rate of its total vehicle fleet by 2030 (ibid.).

Insights into value co-creation at MABI

In this case study, the interviewee has 17 years of experience in the industry and currently serves as a procurement and environmental manager in the sector of MABI Rental Cars. MABI Rental Cars will be referred to in the following as MABI. MABI's primary business model is B2B car rental, with rental durations ranging from one hour to one year. The interviewee has a reserved attitude regarding

whether the rental company can encourage customers to extend the life cycle of EVs. They believe that since the customers' usage time is short, it is unlikely that their usage will affect the vehicle's condition. The interviewee also thinks that customers would treat the rental cars as their own vehicles. These differ from what Reim et al. (2014) and Kuipers (2021) suggested that in the u-PSS model, ownership remains with the supplier, which encourages them to actively extend the product's life cycle.

> "… because nobody wants to crash a car or damage a car. Uh, I think they are responsible, they would treat our product as their own car. I think so."

One of the reasons may be that MABI has signed a buyback plan with its upstream suppliers. After eight months, the vehicles are sold back to the suppliers at a predetermined price, and the vehicle's condition does not affect the buyback price. Therefore, incentivizing customers to extend the EV's life cycle is not a primary consideration in this case.

> "The state-of-the-art, of course, is environmentally and the best. The security level is on top. So we change our whole fleet within eight months. Every year, so every eight months is a new fleet.
>
> So we know exactly how much the car is going to cost us for these eight months…"

The interview reveals that the company focuses more on value co-creation in intangible services rather than the design or production of the tangible product itself. MABI uses various strategies to encourage better customer behavior and consumption. Some of these strategies include:

In terms of design in EV, the company does not involve customers directly in the design of vehicles, as they believe that should be the responsibility of upstream manufacturers.

> "But, we are listening to the customers' need.... we don't have the influence on design. And inside the car design…. Maybe in our office's stations..."

However, they do take customer feedback and needs into account when designing rental services, such as adjusting the rental process. Furthermore, MABI plans to introduce a mobile app next year and implement remote information processing technology (telematic) on each vehicle, making it easier for people to access and monitor vehicle usage. More importantly, this technology can record customers' driving behavior, rewarding safe and responsible drivers and encouraging them to take better care of the vehicles.

> “we can register the driving behaviour of the customers and we can premiere those who are driving safe and we can see that in the data, and we can make sure that if you are driving well. You can get a benefit for it so, but we're discussing that and it's not happening for this year but in the future. And that's good because then you can provide the data to the customer after the rental time and when they see how good they have been driven and get something for it. The next time is they are going to improve so.”

In terms of tangible products, consumers may be able to comment on the materials used in EV production and the production process. However, in the context of intangible services, "production" refers to the processes and systems (Schönsleben, 2019) that enable rental services to operate effectively. Although customers may not directly participate in creating these systems, MABI uses customer feedback and experiences to identify areas for improvement. For example, if customers report difficulty finding or accessing rental vehicles, the company would adjust its vehicle allocation strategy or invest in better location services for its app.

Additionally, the company emphasizes the safety and proper driving of EVs at the counter before handing over the vehicles to customers. Providing rewards for good driving behaviour can further encourage customers to treat their vehicles responsibly. Clear rules and penalties have been established in contracts to control customer behaviour, such as charges for smoking, bringing animals into the vehicle, and causing damage. When asked if there were other ways to improve these behaviours, the respondent felt that a contractual requirement is the most efficient way to discipline consumer behaviour at present.

MABI delivers value to customers by providing convenient and accessible rental services. Also, the service provider checks the condition of each vehicle when it returns and cleans and tidies up it after each use, ensuring that the vehicle is clean and well maintained for the next customer. Additionally, the vehicles are replaced approximately every eight months, so customers always use new cars, which is one of their value propositions.

Finally, the respondent answered that it is challenging for service provider to adopt the role of value co-creation in working with consumers. He felt that they were not manufacturers and did not have enough influence on the design and production of EVs. Moreover, the service provider has usually only owned the fleets for eight months. However, if this kind of collaboration is the future market demand. He would be willing to adopt.

Challenges and customer perspective of EVs

The interviewee indicates that there are several challenges in collaborating with consumers to extend the life cycle of EVs. Firstly, consumers face difficulties in

finding compatible charging stations due to the diversity of payment methods and locations. This makes it challenging for customers to charge the vehicles properly, which may affect the battery life of EVs.

> "They are afraid of electric vehicles at the moment because of the range and so on. It's a problem in Sweden, would you say infrastructure for charging vehicles is varied. I think there are fifteen different payment methods and in different locations. So it's hard for the customer to just fill up the car with electricity.
>
> If the customers get used to driving electric cars, it is gonna be much easier to bring more electric cars to market. Right now it's a behaviour and an infrastructural issue."

At the same time, educating customers on the proper use of EVs, including safe driving techniques, is also an influencing factor. The company provides this information in the vehicle and at the service desk, but customers may not always be aware of these resources. The interviewee points out that consumers' fear of driving EVs and the time required to charge the vehicles also affect consumer behavior.

> "The challenge is to educate the customers on getting use to electric cars and the planning of charging the vehicle. Also to get the customers secure that the range is sufficient."

Co-creating value in MABI's business model

In the context of MABI, the elements related to value co-creation can be identified in the value proposition, value delivery, and value capture as follows:

•Value Proposition: MABI provides convenient and accessible rental services, by listening to customer feedback and needs, allowing customers to have some influence on the services offered by the company.

•Value Delivery: The company educates customers on safety, eco-driving, and other aspects of EVs usage. This collaboration between the company and customers contributes to a better driving experience and potentially increased customer satisfaction. MABI is considering implementing telematics technology and an app in the future, which would enable customers to access vehicles and make payments more seamlessly. This feature is expected to be developed based on customer preferences and requirements, incorporating customer input in the design and development of the service.

•Value capture: credit card, website, penealities, maintenance fee.

Although MABI doesn't explicitly involve customers in the design of their products or services, they do actively listen to customer feedback and needs, which influences their service offerings. Additionally, the company's efforts to educate customers and improve the overall driving experience can be seen as a form of value co-creation, where both the company and customers collaborate to create a mutually beneficial outcome.

4.2 GreenMobility A/S

GreenMobility is a rental company that offers free-floating EV-sharing services. Customers can use and park the vehicles conveniently as needed. Established in Copenhagen in 2016, the company has grown to employ 80 people as of September 2020. Its fleet is composed of 100% zero-emission EVs (GreenMobility, 2022). GreenMobility's business model targets both private individuals and enterprises (GreenMobility, 2023a). The company exclusively uses vehicles supplied by the Renault Group, and by 2022, their fleet contained 1,600 EVs, including both passenger cars and vans (ibid.). One of the main models, the ZOE, is made from 90% recyclable materials, with the interior fabric also being 100% recyclable (ibid.). GreenMobility places a strong emphasis on the circular economy, taking into account the carbon footprint of the upstream production facilities and suppliers, as well as downstream aspects such as the remanufacturing, dismantling, and recycling of end-of-life vehicles and their batteries, and transformed into new resources through waste recovery (ibid.). GreenMobility plans to expand to 35 cities by 2025, operating over 10,000 EVs and saving more than 20,000 tons of CO2 emissions (ibid.).

Insights into value co-creation at GreenMobility

In GreenMobility, the interviewee is the head of marketing in Denmark, who has worked for about seven months. The company primarily focuses on B2B and B2C rental and car-sharing models. They hold a positive attitude towards the possibility of service provision encouraging customers to extend the life cycle of EVs. They believe that user behavior impacts the life cycle of EVs and that encouraging customers to use vehicles responsibly can help reduce maintenance costs for the company. In contrast to MABI and Hertz, it believes that improper customer behavior can affect the next customer, meaning that the behavior of a previous user may influence the satisfaction of the next customer.

Additionally, GreenMobility has signed a buyback plan with upstream suppliers. Within 3-5 years, the vehicles will be sold back to the suppliers at a predetermined price. The company does not currently involve consumers directly in the design and

production of EVs. However, when asked about involving consumers in the design process of EVs, the interviewee indicates that it could be a solution to improve customer relationships, serve as a means to enhance their value proposition, and potentially extend the life cycle of their EVs by encouraging more responsible usage.

> "It could maybe be a solution to actually get customers to be closer to us and also to take care of the cars more than they do now. We are constantly looking to improve the relationship so people will actually take responsible and not throw garbage in the car and you know not drive bad and all that. Maybe it could be a way to do it by inviting the consumer to be part of it."

While the company has not actively involved consumers in the design and production stages, they have paid attention to customer feedback and needs when designing rental services. GreenMobility uses several strategies to encourage better customer behavior and consumption, including:

From the aspect of design, GreenMobility ensures that their fleet consists of 98-99% of the same type of vehicles, making it easier for customers to familiarize themselves with vehicle operation, such as starting, parking, and charging. The EVs are free-floating, which means consumers can park anywhere they want in the zone. Additionally, the company focuses on improving the user experience through the app by exchanging experiences with consumers and testing with customers. This allows users to easily find and book a nearby vehicle, thus building loyalty.

Regarding to production and consumption, GreenMobility places stickers inside the vehicles to convey the proper usage, such as not smoking or carrying pets. The company has established clear rules and penalties in contracts to control customer behavior, but they prefer a more friendly approach when dealing with consumers, rather than relying solely on contracts.

> "But it often is like us trying to teach them something and I really actually want to do it the other way around. So, incentivise in some other way, to encourage them to take care of the car because we all also have a car.
>
> That's difficult for us to figure out."

In terms of maintenance, the company uses second-hand spare parts when repairing vehicles, contributing to environmental sustainability. To incentivize proper usage, the company offers free minutes to customers who charge vehicles with battery levels below 60%. They also rely on customer feedback, asking users to rate the cleanliness of the vehicle after each trip. This rating system helps the company identify vehicles that need cleaning and encourages users to maintain good vehicle

conditions. Furthermore, they communicate expectations through various channels, including newsletters, social media posts, and app push notifications.

> "We also do it in newsletters and social media post and app push notifications. So we're trying to do it from a different kind of a lot of different channels to remind people that we have to take care of the cars."

The interviewee believes that establishing customer loyalty and maintaining strong relationships with users is a key to ensuring proper vehicle usage. They continuously work to enhance the app experience and reward loyal customers. By implementing a combination of design, production, and value delivery strategies, the company encourages users to take good care of vehicles during the usage stage and maintain their quality.

Challenges in prolonging EV life in car-sharing

The challenges identified by the car-sharing service provision to prolong the life of EVs during the use phase include ensuring that customers take responsibility for the vehicles. The company uses stickers, terms and conditions, newsletters, social media posts, and app push notifications to remind customers about the proper use of their vehicles. However, getting customers to comply with these instructions remains a challenge. Another issue involves contagious misbehaviour, where a customer's improper conduct, such as leaving trash in the vehicle or smoking inside, may lead others to believe that such behaviour is acceptable. To address this problem, the company strives to clearly communicate that such actions are prohibited, and if necessary, it may impose fines or block users.

Maintaining vehicle cleanliness is also a challenge for the car-sharing service provider. The company relies on customer ratings to determine when a vehicle needs cleaning. However, ensuring that these ratings accurately reflect the vehicle's condition is unclear. As a result, employees are regularly tasked with monitoring the EVs on the streets and addressing any issues as needed. Additionally, the company faces the challenge of incentivizing the proper use of the vehicles. They offer rewards, such as free minutes for charging vehicles with low battery levels. However, finding effective ways to encourage customers to engage in responsible behaviour remains an obstacle.

Co-creating value in GreenMobility's business model

Based on the interview, GreenMobility's value proposition, value delivery, and value capture can be summarized as follows:

•Value Proposition: 100% EV fleet, promoting eco-friendliness and sustainability. High availability of cars, ensuring users can easily find a vehicle. Competitive pricing, making the service affordable. Free-floating parking, allowing users to park anywhere within the designated zones.

•Value Delivery: Maintaining clean and damage-free vehicles, ensuring a positive user experience. Continuously improving the app experience for finding and booking cars. Rewarding loyal customers who frequently use the service. Collecting user feedback on vehicle cleanliness after each trip, helping to identify vehicles that need cleaning or maintenance. Communicating with customers through newsletters, social media, and in-app notifications to encourage proper vehicle use and maintain the quality of the fleet.

•Value Capture: Automatic payments through the app and users add their credit card details when signing up, and the company withdraws the payment from their account after each trip.

4.3 Hertz international franchisee

Hertz, a car rental company, was founded by Walter Jacobs in 1918 in Chicago, and it expanded to Stockholm, Sweden, in 1960 (Hertz, 2023). Hertz Sweden is comprised of approximately 500 employees and is divided into Hertz First Rent A Car AB and a network of franchisees and agents. The company is a subsidiary of Volvo Car Sweden (ibid.). Hertz is also an environmentally certified car rental company with 211 rental offices and 10,000 vehicles in Sweden, 75% of which are eco-friendly cars (ibid.). Currently, Hertz has corporate, licensee, and franchisee locations in North America, Europe, Latin America, Asia, Australia, Africa, the Middle East, and New Zealand (Hertz, 2023). In addition to car rentals, the company also offers vehicle leasing and fleet management services. Various programs, such as Hertz Gold Plus Rewards, are introduced to strengthen customer loyalty (ibid.). Hertz provides a wide range of vehicle options, including eco-friendly hybrids, EVs, trucks, vans, and Uber rentals, as well as extensive services at approximately 10,300 locations both on and off-airport worldwide (ibid.). Hertz also offers both B2B and B2C services. In terms of environmental impact, Hertz's 2020 annual report highlights collaborations with corporate clients on green travel programs aimed at reducing carbon emissions and fuel costs associated with their vehicle rentals (Hertz Global Holdings, Inc., 2021). The company is committed to integrating environmental sustainability into its operations and reducing waste across its global footprint (ibid.). Recycling efforts include the recycling of used oil

and solvents, tires, batteries, information technology equipment, and general mixed materials, among other items (ibid.).

Insights into value co-creation at Hertz International Franchisee

In an interview with Hertz, the chief marketing officer with 20 years of experience pointed out that their main business is B2B and B2C rental car models, with rental durations ranging from one day to one year. The interviewee did not give a clear answer on whether the rental company can motivate customers to extend the use of EVs. However, he believes that the length of customer usage will affect the customers' expectations and usage methods for the vehicle, especially the interior decoration.

Furthermore, Hertz sells the vehicles back to Volvo after one year of use, based on buyback or guaranteed depreciation plans (Hertz Global Holdings, Inc., 2021).

> "For instance, Volvo, they produce the new car. And we buy that car, we have it in our fleet for like a year. Then we set it back to them. And they can sell it another time as a used car. And that customer might have it for like 3 or 4 years and then that customer will sell it again as a private person. And so, the lifetime of the car could be you know many years."

Hertz does not involve consumers directly in the design and production of EVs, but they do work closely with manufacturers such as Volvo Cars (which owns Hertz in Sweden) to collect consumer feedback and incorporate it into vehicle design and service products, making improvements based on real-world usage experience.

> "Here in Sweden, we are owned by Volvo Cars. During many, many years we have been doing a lot of partnerships with our owners in order to collect feedback from our owners or the dealers. Because we are facing the consumers, the end consumers and so we have a lot of knowledge about what the customers actually want."

Based on the interview, athour can analyze three elements of intangible service value co-creation as strategies to motivate users to take care of vehicles during the user phase:

As to the design, Hertz designs its rental services by offering a range of vehicles, from traditional cars to hybrids and EVs, to meet the needs and preferences of different customers. The interviewee mentioned that they maintain strong communication channels with customers, including social media, and use feedback to improve user experience and satisfaction. For example, through customer feedback, the rental process has been designed to be user-friendly, with easy booking and rental management features and dynamic pricing adjusted according to demand and supply at each location.

> "That's what we're working on every day in the whole organisation. What can we do to come up with an even better customer service that we provide today in all channels or touchpoints where we meet the customers.….The customer is the main focus in in everything we try to achieve here."

In respect of production and consumption, Hertz understands and measures customer satisfaction through online displays and customer service channels, such as Key Performance Indicators (KPIs). The company has set clear rules and penalties in contracts to control customer behavior, such as speeding, improper parking, or traffic fines. When asked whether there are other ways to improve the above behavior, the interviewee believes that using contracts to impose requirements is currently the most efficient method so far. Moreover, vehicles are cleaned and refuelled between each rental to ensure the next customer receives a well-maintained vehicle. Therefore, the misbehaviour would not contagious and affect to the next consumers. Respondent mentioned that is a key difference between rental and car-sharing services.

> "…between every rental in our service, we clean the car externally and internally in the car. And we also refuel the car between every rental or recharge. It's like when you are checking into a hotel. That is one of the differences between our service and car sharing service because in the car sharing service, they just do that once a week. They clean the car internally and every week, but we do it between every rental."

In addition, vehicles are replaced approximately every year, and customers use cars that are less than a year old, which is one of their value propositions.

Hertz's Challenges in prolonging EV life cycle

In this study, Hertz may face some challenges in collaborating with consumers to extend the life cycle of EVs. Firstly, customers have different driving styles and preferences, which can impact the condition and life cycle of the vehicle. When customers rent vehicles for short periods, they might not be as careful or considerate in maintaining the car's quality. Aggressive driving, improper parking, and other inappropriate behaviours can accelerate vehicle wear and tear. The company has implemented terms and restrictions in contracts to address such issues, but enforcing these rules and managing disputes can prove challenging. Furthermore, the company faces difficulties in collecting customer feedback and incorporating it into its service offerings. The shift in car manufacturers' sales strategies, from dealerships to direct sales, has made the process of gathering and leveraging customer insights more complex.

Co-Creating value in Hertz's business model

In the context of Hertz, the researcher analyzes the value proposition, value delivery, and value capture from the perspective of value co-creation.

•Value Proposition: Value co-creation in Hertz's value proposition can be seen in their focus on offering convenience, flexibility, and a variety of rental options tailored to the needs of their customers. They actively collect customer feedback and work closely with their parent company, Volvo Cars, to incorporate this feedback into their service offering. This collaborative approach helps Hertz provide services that are more in line with customer needs and preferences.

•Value Delivery: Hertz delivers value to its customers by ensuring a seamless and convenient experience at every touchpoint in the customer journey. They collaborate with car manufacturers to improve and enhance their services. This process of involving multiple stakeholders in the value delivery process allows for continuous improvement and higher customer satisfaction.

•Value Capture: Hertz captures value from its customers by offering dynamic pricing strategies that respond to market demand and supply. They leverage AI-based tools and market intelligence to make data-driven decisions that optimize revenue. This process incorporates feedback from customers and competitors, leading to a more customer-centric approach to pricing and overall value capture.

4.4 Anymonous marketing team agency

This company requires anonymity, so the following will only briefly introduce the company background of the interviewee. This is an advertising and marketing company, established in Stockholm in 1977, which cooperates with several rental companies in marketing services. Respondents have more than 17 years of experience in cooperating with leasing companies.

Insights into value co-creation in the EV rental industry

The interviewee was responsible for the agency marketing team for the car rental business. According to the interviewee, the current EV rental service is not considered to be specifically designed to improve customer satisfaction. During the rental period, the customer's role in extending the vehicle's life cycle is minimal. Additionally, car rental companies do not collect customers' insights on design and value propositions to meet their needs, as this responsibility falls on the car manufacturers.

> "...that the manufacturers of cars and models work in 10-year cycles. What we will see next year they worked on it for five years already or 10 years. There's a discrepancy where we don't feel that we can actually influence the manufacturer in any meaningful way."

> "....We offer hypothetically and BMW3 series hybrid. But all the other car rental companies Hertz, Budget, Europcar, and any of the other ones are competitors that are offering the same exact car. So there's I mean there's no such thing as a XXX (the name of rental company) car rental. People are renting a model and they are renting a BMW or Toyota or a Kenya. For any other brands, we just a service provider. So in that sense, it's not our car."

However, the interviewee does acknowledge the growing demand for EVs in the market, and the primary challenge for car rental companies is to acquire enough EVs to meet this demand. The interviewee also considers that long-term renters tend to take better care of the vehicles compared to short-term renters. When it comes to customer misconduct, such as smoking and leaving trash in the vehicle, the interviewee thinks it's not an issue, as it rarely happens in rental situations.

The interviewee ensures that vehicles are cleaned and charged after each rental period, maintaining their reliability. In conclusion, the interviewee indicates that traditional car rental companies face challenges in adopting to digital maturity and keeping up with the rapidly developing shared services market. There are no challenges in extending the life cycle of the vehicles during the usage stage, as the vehicles have a short life cycle under the care of the rental company.

> "We're gonna let you have 1000 of the new BMW3 series and you will have them for six months. So the deal is already set beforehand that there is a purchase price for the vehicle and there's also an already decided sales price. So it goes back to the manufacturer after six months."

Overall, the interviewee believes that EV rental services contribute to sustainable production and consumption. However, there are limitations in car rental businesses when it comes to value co-creation in tangible product aspects such as design, production, and value delivery. As car rental companies are service providers and not car manufacturers.

The perspective of challenges in extending EV life cycle

In terms of challenges, according to the interview, the respondant believes that the main challenge in collaboration between car service providers and consumers to extend the life cycle of EVs is related to supply rather than consumer behavior. The window for car rentals is short, typically six months, while the vehicle's life cycle extends far beyond that period.

> "The car rental window is really short and in the very early phases and there are so many following phases that I don't think that the car rental consumer plays a role at all."

The interviewee also mentioned that there is a significant demand for electric EVs in the rental market, but the main challenge lies in acquiring enough EVs to meet this demand. The interviewee believes that car rental consumers do not play a crucial role in extending the vehicle's life cycle during the usage stage.

4.5 Buyback agreements

From the finding, the researcher learned that all four companies had signed buyback agreements with their upstream suppliers. Due to these buyback agreements, the rental companies have temporary ownership for a period of eight months or one to five years. This emphasizes that the life cycle of EVs does not end at the user stage or returns to the rental companies for recycling and reuse, as shown in Figure 6a. The ideal sustainable EV life cycle. In reality, EVs are sold back to upstream suppliers under conditions ranging from new to only eight months or one to five years on the road, as in Figure 6b. Empirical finding in the EV rental industry. The rental companies would purchase another fleet of brand-new vehicles from the upstream supplier for their customers.

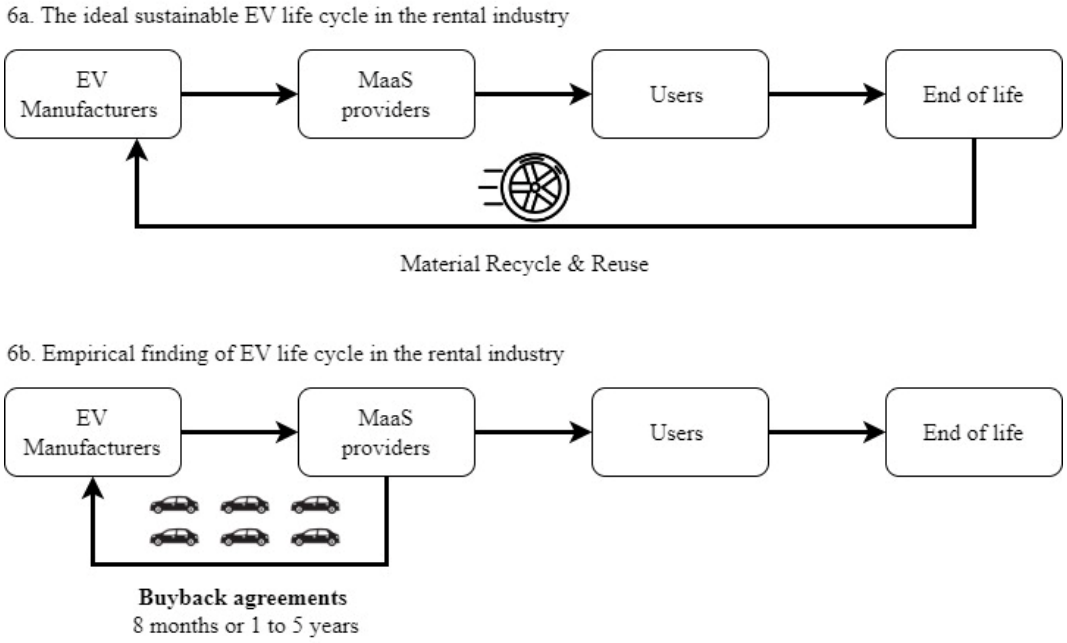

Figure 6. The comparison of the ideal sustainable product life cycle and empirical findings in the EV rental industry.

5. Analysis and discussion

In this chapter, the analysis of the empirical study is used to answer the research questions and to discuss the current situation and challenges and potential benefits of value co-creation spacess adoption by rental service providers.

5.1 MaaS providers' co-creation in service and EVs design, production, and consumption

In this section, the empirical data related to the first research question will be analysed and discussed. Question 1 will be answered below, on how MaaS providers are using the co-creation strategies to optimize the services they offer, and their views on engaging with customers in the design, production and consumption of EVs.

Research question 1: How do mobility-as-a-Service providers co-create their service with users to promote a more sustainable product life cycle?

In the areas of intangible service design, production and consumption, rental and sharing service provisions all conduct various social media platforms or application to maintain ongoing communication experience exchange with end customers. By doing this, it could collect feedback and ideas to improve services and enhance user experience. This helps to identify and address issues before they become significant problems, ensuring that vehicles remain in good condition and have a longer life cycle. Contracts and punitive measures are employed to encourage better customer behaviour and consumption, such as clear rules and penalties, visual reminders (stickers), and rewards. Both rental and car-sharing companies have established buyback plans with their upstream suppliers.

As shown in Table 3, in comparison to the other three companies, GreenMobility is a car-sharing service providers that uses 100% EV, which can be parked and stopped at any time and anywhere. The interviewee specifically mentioned that they use second-hand spare parts for EV maintenance. In contrast to the other three rental companies, GreenMobility relies more on customer autonomy and customer

feedback ratings for vehicle cleanliness and regular maintenance, rather than cleaning between each rental like MABI or Hertz car rental providers.

Table 3. Co-creation of MaaS providers in design, production, and consumption of intangible services.

MaaS providers	Design	Production & Consumption
MABI Rental Cars	*Various options of vehicle, station-based parking	IT service update, social media platforms, contracts, incentivizes program, eight months of ownership, cleanliness maintained by providers
GreenMobility A/S	100% EV, Free-floating	Uniform fleet, Media channels, uses second-hand maintenance parts, contracts, free charging minutes, three to five years of ownership, customer-maintained cleanliness, displays stickers on usage guidelines
Hertz international franchisee	Various options of vehicle, station-based parking	Social media platforms, contracts, incentivies program, one year of ownership, cleanliness maintained by service provider
Anymonous marketing team agency	Various options of vehicle, station-based parking	IT service update, eight months of ownership, cleanliness maintained by provision

*Various options of vehicle: diesel, gasoline, plug-in hybrid and EVs

In terms of the tangible product EVs, from Table 4, the rental companies describe that they merely offer vehicle models predetermined by upstream manufacturers. They do not have any influence to modify the design or production materials of EVs. Particularly, MABI and anonymous agency argue that their influence in encouraging better consumer behaviour by involving customers in product design and production is limited. They also believe that upstream manufacturers are better suited for this role. This may be because rental companies have a limited ownership period for their products. After a specific time, the vehicles can be repurchased at a fixed price. This buyback price model ensures the company's profit capture and allows suppliers not to worry about the vehicles' longevity. However, it may also cause them to overlook the role that value co-creation could play in extending the life cycle of the vehicles. In the car rental supply chain, car rental and sharing service provisions could influence consumers the most (Belk, 2014). Because these providers directly interact with customers, offering various rental options, prices,

and services. Their customer service, fleet quality, and convenience of pick-up and drop-off locations significantly impact the customers' decisions and experiences (ibid.).

Table 4. MaaS providers' perspectives on the three co-creation spaces of the design, production and consumption of EVs.

MaaS providers	The view point of co-creating more sustainable product life cycle for EVs
MABI rental car	The provider does not consider that they have influence over the design or production of EVs and furthermore, they only have eight months of ownership of the fleet.
GreenMobility A/S	The EV-sharing company has not implemented co-creation with its customers on its products. However, it is believed that this type of collaboration can bring the customer closer and could be an alternative solution to extend the life of EVs.
Hertz international franchisee	Hertz does not involve consumers directly in the design and production of Evs, but they do collect end-consumer feedback and work it into vehicle design and service products with Volvo manufacturer and their dealers.
Anymonous marketing team agency	The company believes that it is the responsibility of the manufacturer to work with the customer to optimise design and production and they do not have the influence to do so.

5.2 The challenges and benefits of the co-creating practice

In this section, the following answers **research question 2: What are the challenges and benefits for Mobility-as-a-Service (MaaS) providers to co-create more sustainable life cycles with users?**

The challenges of prolonging the EV's life cycle

The EV rental service provisions face several challenges when collaborating with consumers to extend the life cycle of EVs. First, the diversity of payment methods and locations for charging stations presents a challenge for customers, making it difficult for them to charge their vehicles correctly. As a result, it may affect the battery life of EVs. Second, educating customers on the proper use of EVs, including safe driving techniques and charging planning, is essential. However,

customers may be unaware of the resources provided by the provision, and fear of driving EVs and the time required for charging may impact consumer behaviour. Third, car-sharing service provider pointed out that encouraging customers to use vehicles responsibly is a challenge because it is difficult to predict whether all consumers will follow the rules. Relying on customer ratings to reflect the cleanliness and condition of a vehicle can also be a problem, as it's uncertain whether customers are giving points correctly. Fourth, using second-hand spare parts for EV maintenance contributes to the circular economy, but it may raise questions about the quality and reliability of these parts. The long-term effects on the vehicle life cycle need further evaluation. Finally, the relatively short ownership periods reported by some rental companies (eight months to one year) may not be the best choice for extending the vehicle's life cycle, as they might encourage a more disposable mentality.

Potential benefits of co-creation for service provisions

At present, customer participation in EV design and production mainly comes from major manufacturers such as BMW and Tesla…etc. However, it also holds significant importance for car rental and sharing companies. Service providers offer customers the right to use vehicles, focusing on aspects like fleet management, pricing, and customer service. Their core business is not in the design and production of vehicles, which is the domain of automobile manufacturers. Nevertheless, rental companies have the potential to contribute to the extension of vehicle life cycles and the development of a circular economy in terms of co-creation with their customers.

First, by not participating in the co-creation practices, service providers may miss opportunities to address the specific demands and preferences of their customer base. Customized vehicles tailored for leasing purposes can enhance user experience, leading to better maintenance and possibly extending vehicle life. In terms of contributing to sustainable practices, MaaS providers can play a role in promoting sustainability, such as eco-friendly materials and design, by providing feedback to manufacturers during the co-creation practices with customers. If they do not participate in this process, they may inadvertently encourage less sustainable practices and hinder the progress of the circular economy.

As they do not perceive themselves as essential in the co-creation process, rental service providers may not share valuable customer feedback and insights with manufacturers. Some information may be crucial for continuous improvement and adapting vehicles to meet customers' ever-changing needs, thus extending the vehicle life cycle and promoting the circular economy. Besides, EV rental and

sharing companies have unique insights into customer behaviour and preferences in short-term vehicle usage. Ignoring their role in the co-creation approach may hinder potential innovation in vehicle design and features, which could benefit leasing customers and the circular economy.

By acknowledging their potential contribution to customer co-creation and collaborating with automobile manufacturers, rental service providers can help extend the life cycle of vehicles and promote the circular economy. By focusing on sustainability, user experience, and customization, they can increase the overall value provided to customers and support environmentally responsible practices.

5.3 Discussion

This study shows that the u-PSS business model for EV rental service providers could enhance co-creation spaces and facilitate sustainable product life cycles with users. Meanwhile, it also identifies the limitations of the co-creation spaces with customers, as some functions can be co-creative with users, such as intangible services, but some cannot be co-creative, such as the tangible product EV.

Previous literature suggests that the concept of u-PSS underpins sustainable production and consumption. It aims to reduce product sales volume, thus balancing the impact on the environment and society. Unlike the linear economy, this model keeps ownership with the providers, encouraging them to actively engage with users in prolonging the lifecycle of EVs, thereby reducing the consumption of natural resources and waste generation. However, empirical research shows that MaaS providers like EV rental companies are more focused on promoting their services to maintain fleet quality than working with users to make the design, production and consumption of EVs sustainable. While co-creation in the service domain contributes to the maintenance of EVs quality, in the finding, the rental companies are more likely to promote the tangible EVs on business-to-business (B2B), not on business-to-consumer (B2C). As a result, service providers may miss the opportunity to extend the lifecycle of an EV with the users.

Furthermore, in the literature review, the u-PSS business model emphasizes that service providers retain product ownership throughout their whole life cycle, with the products being eventually recovered and reused after the end of life. However, this study indicates that product ownership in the rental industry is temporary due to buy-back agreements with upstream suppliers. This agreement shows that after a period of time ranging from eight months to one or five years, the supplier can sell back directly to the manufacturer at the price previously agreed. This is different from the u-PSS model mentioned in the literature, where the products

would remain within the circular system and continue to be recycled and reused. The destination and subsequent development of the EVs in this study remain unknown.

Finally, the literature suggests that the service providers adopting the co-creation approach could encourage more responsible use of vehicles by users. In reality, however, the design of EVs has been pre-determined and service providers believe that upstream manufacturers should take more responsibility for promoting a sustainable EV life cycle. In addition, the reality of the u-PSS business model for the EV leasing industry, which only allows service providers to own EVs for a short period of time, has led to a perception by service providers that they have limited influence in terms of co-creation with their customers.

6. Conclusion

This chapter provides a summary of the key findings obtained from the research. The following section discusses the contributions of these findings to the existing knowledge and literature. Additionally, the chapter acknowledges the limitations of the study and provides suggestions for future research directions.

This research aimed to explore the role of Mobility-as-a-Service (MaaS) providers in the co-creation spaces, specifically how they co-create their services and products (EVs) with users to achieve sustainable product development. Additionally, the study aimed to identify the challenges faced by service providers in this co-creation spaces and the potential benefits they can obtain.

The findings of this research indicate that in terms of service design, production and consumption, MaaS providers under the u-PSS business model can enhance the sustainability of product lifecycles to some extent through co-creation with users. However, it is also evident that the role of MaaS providers within the u-PSS business model can be limited in influencing the co-creation of the design, production, and consumption of EVs. The actual impact of u-PSS leasing services on promoting a circular system is not fully aligned with the descriptions in the literature. For example, the literature suggests that u-PSS enables providers to retain ownership and encourages them to actively extend the life cycle of EVs. However, when buyback agreements between manufacturers and service providers occur, the influence of consumers on the EV life cycle becomes minimal as the product life cycle does not end at the consumer stage. Furthermore, the buyback agreements provide profit assurance for service providers, and temporary ownership alleviates their concerns about the long-term quality of EVs. The shortened tenure of service providers due to buyback agreements may limit the development of u-PSS towards sustainable goals. Moreover, in the supply chain of the EV rental industry, the ultimate destination of the EV is returning to the upstream manufacturers, which creates uncertainty regarding the future of EVs.

This study identifies several challenges faced by these MaaS providers. Issues range from the complexity of charging stations to education on the proper use of EVs and the reliability of customer feedback mechanisms. Further, concerns exist about the

quality of second-hand parts used for EV maintenance. Lastly, these rental companies have agreements with upstream manufacturers for periodic buybacks, which may lead to limited ownership durations and weaken their influence on customers. Despite these challenges, potential benefits can arise from actively involving customers in the co-creation spaces. This could range from addressing specific customer needs to promoting sustainable practices, such as eco-friendly materials and design. Moreover, communication of customer insights between rental service providers and manufacturers can facilitate continuous improvement and adjustment in vehicle design and functionalities. This, in turn, can extend the vehicle's life cycle and promote a circular economy.

6.1 Contribution

The main contribution of this study identified the differences and limitations between the ideal and actual execution of MaaS providers in the u-PSS business model when engaging in co-creation with customers. While MaaS providers have the potential to contribute to a sustainable product life cycle through the co-creation approach, factors such as buyback agreements and short-term ownership raise questions about their impact on the overall product life cycle and the achievement of long-term sustainability goals. Furthermore, the empirical analysis reveals that MaaS providers, particularly in the rental and sharing service sector, actively engage in co-creation spaces with customers through various social media platforms and communication channels. They collect feedback and ideas to improve their services, address issues, and enhance user experience. Contracts, penalties, and rewards are used to encourage responsible consumer behaviour. The findings emphasize the importance of ongoing communication and engagement with customers in maintaining vehicle quality and extending the life cycle of EVs.

Overall, the contribution of this study urges MaaS providers and other stakeholders to reassess and adapt their business practices. Such a reevaluation has the potential to foster the role of MaaS providers, and increased customer involvement, satisfaction, and loyalty, ultimately benefiting both the providers themselves, their customers, and the environment. Moreover, this research promotes the responsible use of EVs, potentially reducing resource exploitation and waste generation.

6.2 Limitation

The primary limitation of this study is the breadth of data collection. The insights were only drawn from interviews with three Swedish rental companies and one Danish rental company, which may not be fully representative of the diverse

perspectives within the industry. If the study could be expanded to include a wider range of rental and mobility service providers, a deeper understanding of the process of value co-creation and its challenges and benefits would be possible to obtain. In addition, each rental company's relationship with upstream manufacturers can shape different perceptions of the extent to which customers are involved in value co-creation spaces. Furthermore, due to cultural and contextual factors, the focus of this study is on companies in Sweden and Denmark. Therefore, these insights may not be applicable to MaaS providers operating in different cultural or regulatory environments.

6.3 Future research

Future research could move towards exploring the movements of rental EVs throughout their lifecycle. The subsequent lifecycle of rental EVs is unknown due to buy-back agreements between the manufacturers and service providers. Additionally, it could extend data collection for comparative studies across various regions or countries. This would provide more insights into how cultural, regulatory, and market conditions impact the value co-creation approach and sustainable practices of MaaS providers. Involvement from other participants could also be explored, such as gaining insights into customers' perspectives on the value co-creation approach and their collaboration experiences with MaaS providers. Understanding customers' views and reactions to these initiatives can offer valuable insights into improving and optimising the three co-creation spaces, which can further enhance the sustainable life cycle of products. Additionally, incorporating other stakeholders like EV manufacturers or policy-makers into future research could offer a more comprehensive view of the value co-creation approach within the MaaS ecosystem. Finally, as technology evolves rapidly, it would be interesting to explore how emerging technologies like artificial intelligence or blockchain can be fostered the co-creation approach and promote sustainable practices in the MaaS sector.

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Appendix 1 Interview Guide

Aim:
The goal is to investigate how the Mobility as a Service initiative can work with consumers to create sustainable user behaviour, which means enhancing the extended life of electric vehicles by engaging with customers.

RQ1: How do service providers use the value co-creation as a cooperative strategy to motivate user's to take care of the vehicles during the user phase?
RQ2: What challenges are identified by service provisions to cooperate with consumers to prolong the EV's life cycle?

Questionnaire for all other semi-structured interviews:
Q1. What is your role and function within the company?
Q2. How long have you been working for the company?
Q3. Can you briefly introduce what does product does your company sell?
Q4. What is your company's value proposition in EVs sharing or rental service?
Q5. What do your customers values the most in your EVs sharing or rental services?

- How the company is working to enhance customer satisfaction?

Q6. Do you involve your consumers in designing the product?

- Do you think this kind of collaboration with consumers will lead them to take more care of their car and drive it properly

Q7. Does the company work with manufacturers or service providers to take customer feedback into account in your designs or service offerings?

- If so, how do you do this?

Q8. How does the company deliver value to customers?
Q9. Does customer behaviour will affect the life cycle of the vehicle?

- For those inappropriate behaviour, how to communicate with customers and establish a relationship to improve?
- Do you think those misbehaviour during use is contagious? For example, smoking, leaving litter, aggressive driving.
- Instead of using contracts to make them to follow, is there any other incentive mechanism that could prevent misuse?

Q10. Is there any challenge for you to have customers to use the EVs properly and

to maintain the quality of the vehicle?

- If so, what are the challenges or problems? How do you solve these problems?

Q11. Does the length of rental time influence the customers' behaviour in using the vehicle?

- If so, how do you help customers to properly use in short-term rentals?

Q12. How does the company capture value in return?

Q13. How do you ensure that the application for booking and managing rentals is user friendly to improve cash flow management?

Q14. What challenges are identified by car rental or sharing service providers to prolong the life of EVs in the use phase?

Q15: What contributions do you hope the academic research can provide to this topic?

Q16. Is there any information you would like to add?

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