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Stakeholder's perceptions and acceptance of autonomous driving, shared mobility, and business innovations

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Abstract

This Master thesis explores the transformative potential of autonomous vehicles (AVs), shared mobility services, and the broader CASE (Connected, Autonomous, Shared, and Electric) mobility paradigm. Focusing on three key stakeholders—Original Equipment Manufacturers (OEMs), Public Transport Providers (PTPs), and Shared Mobility Companies (SMCs)—the study aims to understand their perceptions and acceptance of these emerging trends. The research delves into Mobility as a Service (MaaS), vehicle subscription models, and data monetization business models, which promise to revolutionize transportation by offering flexible, sustainable, and user-centric solutions. AVs are pivotal in reducing human error and improving traffic efficiency, while shared mobility services reduce the need for car ownership, thus alleviating urban congestion and pollution. MaaS integrates various transportation modes into a single accessible platform, enhancing convenience, and vehicle subscription models provide users with flexible access to vehicles without the long-term commitment of ownership. Data monetization models leverage the vast amount of data generated by modern vehicles to create new revenue streams and enhance service offerings.

The investigation centers on critical aspects such as pricing strategies, willingness to adopt new technologies, technology and IT requirements, and the associated short-term and long-term opportunities and risks, including the need for significant investments. To gather comprehensive insights, companies and industry experts were approached through surveys and interviews. This method allowed for a detailed exploration of the various factors influencing the adoption and success of these innovative business models.

The results from the surveys and interviews provide valuable insights into the critical features and aspects of AVs, shared mobility, and CASE mobility. Key findings include stakeholder willingness and acceptance, optimal price points, consumer preferences, and the overall opportunities and concerns associated with these technologies. The research highlights strategic areas for future focus, including partnerships, technological advancements, and addressing consumer needs, thereby offering a roadmap for stakeholders to navigate and capitalize on the evolving mobility landscape.

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Abbreviations

AV	Autonomous Vehicles
BEV	Battery Electric Vehicle
BM	Business Models
CASE	Connected, Autonomous, Shared, and Electric
CAV	Connected and Autonomous Vehicles
CPS	Cyber Physical System
EMPS	Electric Mobility Products and Services
EV	Electric Vehicles
ICE	Internal Combustion Engine
ICT	Information and Communication Technology
IoT	Internet of Things
MaaS	Mobility as a Service
NMS	New Mobility Services
OEM	Original Equipment Manufacturers
OTA	Over-the-Air
PTP	Public Transportation Providers
RPA	Robotic Process Automation
SDV	Software-defined Vehicles
SMC	Shared Mobility Companies
TNC	Transportation Network Companies
P2P	Peer to Peer

1. Introduction

The automotive industry is in the midst of a transition, witnessing the combination of four disruptive areas: Connected, Autonomous, Shared, and Electric (CASE) technologies. This convergence represents a critical turning point, pushing the transportation sector into a new era of mobility and redefining its conventional boundaries. The innovative potential that lies within CASE technologies is exemplified by the following: shared mobility services that challenge established ownership models; autonomous driving systems that navigate roads with greater independence; connected vehicles that bridge the disparity between vehicles and the digital world; and electric propulsion that ushers in a sustainable shift in source of power. The convergence and interplay of these innovative pillars not only reshapes the automotive industry but also establishes the foundation for an exciting time where mobility is marked by increased efficiency, interconnectivity, and a commitment to sustainability.

As the significance of CASE technologies grows, creative and innovative business models (BMs) are taking a leading role in determining the trajectory that mobility will take going forward. Ideas such as 'vehicle subscription' and 'data monetization' have completely altered the manner in which consumers perceive vehicles. These innovations offer novel ways for consumers to access mobility services while leveraging the immense data generated by interconnected vehicles. By offering flexible access to cars through subscription-based services, the concept of vehicle subscription upends conventional ownership models. At the same time, data monetization tactics leverage the plethora of data generated by connected vehicles, providing views into consumer ethics, traffic patterns and needed infrastructure. The present state of the industry is being transformed by these innovative business models, which also change consumer behaviour and offer opportunities and challenges to stakeholders all over the mobility spectrum.

Perceptions and acceptance by stakeholders throughout the automotive ecosystem are vital for the success of CASE technologies and innovative business models in the mobility scenario. The viewpoints, requirements, and adaptability of a diverse range of stakeholders, that include Original Equipment Manufacturers (OEMs), public transportation providers (PTPs), shared mobility companies (SMCs), regulatory bodies, urban planners, infrastructure providers, and end-users, strongly influence the adoption and acceptance of these transformative technologies. To be able to formulate efficient policies, strategies and applications that promote accessibility, trust, and seamless adoption in the constantly changing mobility industry, it is necessary to understand stakeholder needs and demands.

1.1 Aims and research questions

The aim of this thesis is to analyse how different stakeholders perceive autonomous driving, shared mobility, and the rapidly developing BMs in the context of a CASE mobility future. Understanding the different perspectives of stakeholders, focusing on OEMs, PTPs and SMCs—about the acceptance of automated driving technologies and shared mobility solutions is one of the main goals of the study.

Furthermore, by investigating stakeholders' awareness, concerns, and receptiveness to these changing paradigms within the automotive industry, this research aims to investigate the nuanced reception and discernment of BMs generated by these transformative concepts.

To address the above topics, I will be looking at the following research questions:

- **Research Question 1** - How do key stakeholders perceive the integration of automated driving technologies and shared mobility services in the current and future landscape, and what factors influence their attitudes and acceptance toward these advancements?

- **Research Question 2** - What views and understandings do stakeholders in the automotive industry have about Mobility as a Service (MaaS) and what potential advantages and difficulties do they see?

- **Research Question 3** - How do stakeholders in the automotive industry perceive vehicle subscription models in terms of their strategic implications and effect on consumer behaviour and market dynamics?

- **Research Question 4** - How do stakeholders in the automotive industry perceive the advantages, difficulties, and ethical concerns linked with using vehicle-generated data for monetization purposes?

1.2 Structure of the thesis

The thesis is structured into four main parts, comprising a total of seven chapters.

Chapter One provides a brief introduction to the thesis and the corresponding research. It outlines the aims, objectives, and research questions that the study seeks to address. This chapter sets the stage for the entire thesis by establishing the context and importance of the research.

Chapter Two delves into the relevant background of the topic. It familiarizes the reader with key concepts, terms, and ideas that are foundational to the thesis. This chapter also introduces the concept of CASE mobility and provides the necessary definitions and context.

Chapter Three focuses on the automotive industry, presenting a comprehensive timeline that covers traditional BMs, their transformations, and the shifts that have occurred over time. It also discusses emerging BMs in the automotive industry, providing a broad overview of the industry's evolution.

Chapter Four explores the concept of MaaS in depth. It examines the scope, benefits, implementations, drivers, and barriers of MaaS, along with real-life applications and the BMs that have emerged from this concept. This chapter provides a detailed analysis of how MaaS is shaping the future of mobility.

Chapter Five outlines the research methodology used in the study. It provides an in-depth look at the survey and interview methodologies employed, detailing the data collection process and the analytical techniques used. This chapter also hints at the results and findings that will be discussed later in the thesis.

Chapter Six focuses on analysing the data collected and deriving insights. It answers the research questions in relation to the stakeholders considered in the study. This chapter is critical in translating data into meaningful conclusions that address the core research objectives.

Chapter Seven, the final chapter, serves as a conclusion. It synthesizes the insights gained from the research, offering a perspective on the potential future of CASE mobility. This chapter reflects on stakeholder perceptions and discusses the broader implications of the findings for the future of mobility.

2. Relevant background of the topic

With customer needs changing, technology innovation converging, and a resolute commitment to sustainability, the automotive sector is poised for a massive revolution. Vehicles are an essential part of everyday life, but they are much more than just means of transportation these days. They are complex networks of cutting-edge technology, mobility solutions, and social integration. A radical rethinking of conventional automotive concepts is at the core of this evolution. The industry is

currently undergoing a transition toward connectivity, autonomous capabilities, shared mobility services, electrification, after being historically propelled by internal combustion engines and mechanical terminologies. These revolutionary developments alter not only the vehicles themselves but also the ecosystem that includes manufacturing, infrastructure, mobility services, and user experiences. As stated by Wells (2013), the economic, environmental, and social challenges are the reasons why the existing automotive industry is unsustainable. According to Chrysakis (2017), vehicle manufacturers, or OEMs, have been able to boost sales for a long time by using conventional business methods in the automotive sector and consistently delivering incrementally better customer experiences. Chrysakis (2017) also says that the automotive industry as a whole has been on a forefront because of developments in electrical and mechanical engineering. The digital disruption has a potential of transforming the automotive industry on a huge scale because of the opportunities it provides for smart and autonomous vehicles (AVs) which can communicate, socialise and collaborate with other things, like other vehicles, traffic lights etc., and enables them to be a part of the 'system of systems'. *"Customers, shareholders, and governments expect innovations in the field of new mobility solutions and car-sharing, autonomous driving and connected services, as well as environmentally friendly drivetrains"* (Mann, et al., 2023). *"More and more traditional companies are realizing that to compete and grow in a digital world, they must look, think, and act like software companies themselves,"* according to a recent essay by Gnanasambandam, et al. (2022).

2.1 What is 'mobility' with respect to the automotive industry?

In the automotive sector, "mobility" refers to a broad, dynamic idea that goes beyond the conventional understanding of cars as modes of transportation. The automotive ecosystem now incorporates a variety of transportation modes into its mobility offerings, such as ridesharing, public transportation, electric scooters, private vehicles, and soon-to-be AVs. In addition to addressing the process of traveling from point A to point B, this holistic approach also considers the larger ecosystem of services, infrastructure, connectivity, and user experiences. PWC authors Kuhnert, et al. (2018) state that the traditional industry target numbers, namely vehicle sales and vehicle inventory, will become less significant if suppliers and manufacturers broaden their BMs to include "operational" aspects. In the white paper of Spulber et al. (2016), it is stated that mobility is a user-centric concept, which means that it realizes the need for transportation services and products to be responsive to the requirements, habits and preferences of both society and travellers. For the past twenty years, a plethora of new options for passenger transportation – collectively referred to as New Mobility Services (NMS), have been emerging. These services offer transportation as an on-demand shared services, allowing users to have access to vehicles (cars, vans, bikes, etc.) for a short-term and on demand basis. NMS often indicate a strong distinction between traditional ownership and shared models, as well as public and private modes of transportation. Spulber et al. (2016) also states that the evolution of mobility is being enabled by NMS. They are a part of the progressive shift in travel behaviours, particularly in urban areas, towards a less car-centric multimodal system. Despite the continuing diversification of the transportation industry, this gradual shift will enable established automotive players, vehicle manufacturers in particular, to adapt and hold onto their market position.

According to a report from ITF (2021), the components of everyday mobility are intricately linked, robust, and deeply ingrained, and they go well beyond the boundaries of the transportation industry and the urban environment. The report also states that it is particularly true when one considers the function of the automobile in cities. Rethinking the connection between car use and urban mobility will be necessary to address global challenges related to urban mobility, and this will not be an easy task. Even though the majority of people still lack access to cars, a sizeable portion of the global population desires to own one (ITF, 2021). On the other hand, countries with earlier motorization and

higher number of vehicles are beginning to consider moving away from a singular focus on car use in urban settings. The report also focused on how urban mobility landscape is transforming rapidly, with new layers, more options, and an increasing number of digital components. Established incumbents and upcoming mobility services share the same urban mobility landscape, which can lead to both opportunities and challenges. The majority of cities have tensions that are made worse by the absence of a cohesive framework that covers all aspects of urban mobility services. Change-related initiatives must take system inertia and established behaviours into consideration. It is unlikely that merely providing an alternative to current methods will cause a change in macro-level trajectories or individual behaviours. In order to encourage the adoption of new options, it is important to take into consideration the deeply ingrained "system of provision" that gives rise to the current car-oriented urban mobility practices. Stakeholders in urban mobility will need to arbitrate disagreements in order to effectively map out a course for the future. These divergent opinions show, among other things, the optimism that some have for technology-led approaches, particularly electromobility, the importance that others think collective transportation must play, and the growing belief that better planning can preserve access to opportunities in urban areas with low overall travel volumes. Fig.1 shows a general depiction of how the automotive industry has emerged between the industrial era and the digital age.

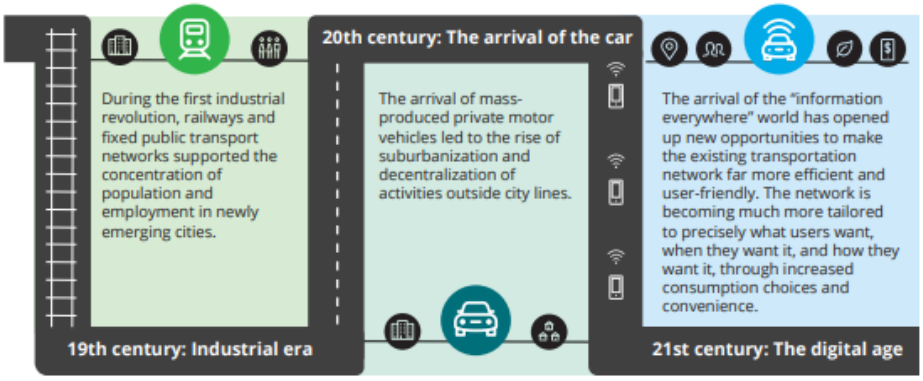


Fig. 1 Mobility through the ages *(Goodall, et al., 2017)*

2.2 How is digitalization transforming the automotive industry?

Automotive companies, like all businesses, want to digitize their operations to gain various benefits like productivity and observability. Examples of digitization include data, cybersecurity, and connectivity. This digitization is made possible by a variety of innovative technologies, including robotic process automation (RPA), task mining, process mining and deep learning algorithms. (Dilmegani, 2021).

According to Oliveira and Novikau (2022), it is important to start by discussing the increasing use of big tech in projects in recent years to comprehend the factors that are driving the automotive industry to adopt digitalization. The five most valuable companies in the world, Google, Amazon, Facebook, Apple, and Microsoft, also called GAFAM, are significant examples of the digitalization process and the transformation of traditional industries. Oliveira and Novikau (2022) also state that this push into the automotive industry may be explained by the pervasiveness of these businesses in society and their diversification beyond the digital sphere. These companies can convert massive amounts of data from billions of users into knowledge through the use of emerging technologies like machine learning, deep learning, and algorithms. The knowledge they gain from this process can then be turned into products and services that generate revenue. These initiatives strengthen the companies' already substantial financial resources, which they are using to break into industries not typically associated with the digital space, such as healthcare, pharmaceuticals, mobility, and transportation, IoT solutions, and

others (Wollschlaeger, et al., 2015). There is uncertainty, though, about how this new challenge will upset the industry's established order. High entry barriers, such as significant investments in fixed capital, machinery, design skills, and tacit knowledge, are the foundation of traditional BMs. The process of digitalization is still in its infancy, and the established major players may not see any immediate benefits (Oliveira & Novikau, 2022). Currently, businesses are characterized by rapid technological advancements, and digitalization is a revolutionary force that is changing the automotive industry. Every facet of the automobile industry has been impacted by digitalization, including consumer experiences, design and manufacturing procedures, and the fundamental idea of mobility. According to Srivastava et al. (2020), businesses that are prepared to address deeply ingrained structural and cultural impediments are seeing the highest returns on their software investments. Along the way, this transformation not only improves vehicle efficiency and performance while also redefining dynamics of the industry and customer expectations. Strategies from digital transformation are crucial because they showcase how pervasive the changes resulting from digital technologies are inside a firm (Chanias & Hess, 2016). Considering that the research and thesis aims at understanding BMs around autonomous driving and car sharing platforms, and in order to react to these changes, companies must alter their traditional BMs, which have been running for many years (Kotarba, 2018) (Riasanow, et al., 2017).

According to Wollschlaeger et al. (2015), not all digitally disruptive services will be created equally and that some will likely be much more significant and profitable than others. It is not obvious, though, that OEMs will reap the full benefits of the digital disruption. It is imperative for all stakeholders involved in the automotive value chain to exercise caution regarding the rapid and significant changes occurring in other industries. As stated by a report from PWC authors Kuhnert, et al. (2018), it won't be enough in the future to solely focus only on the manufacturing and marketing of automobiles. To manage the changes across the four dimensions of the CASE model, manufacturers and suppliers must reconsider their business model. The automotive value chain will now span all forms of use over the course of a vehicle's lifetime, ending with recycling, rather than ending at the factory door. The automotive industry's target consumers and customers will now include all product users, both in private and shared usage models, rather than just direct car buyers. Software-based, one-on-one communication with each user, bolstered by the brand experience, which is already a crucial component – will result in an increased revenue over the lifecycle of the customer relationship (Kuhnert, et al., 2018). In the following sections, the thesis will delve into the progression and advancement of CASE mobility technologies. This comprehensive exploration will focus on how these cutting-edge innovations are reshaping the future of transportation and mobility. The authors will examine the transformative impact of CASE technologies, uncovering the multitude of new opportunities they are creating in areas such as urban planning, environmental sustainability, and economic development.

2.3 Evolution of CASE technologies in the automotive industry

The confluence of CASE technologies is causing a revolutionary change in the transportation industry. The future of mobility in this dynamic period can be redefined by merging automated driving technologies and shared mobility. Central to the successful implementation of these advancements lies the complex interplay of stakeholder engagement, perception and acceptance within the ecosystem.

According to Martínez (2018), the acronym CASE first emerged as a phrase for the future of vehicles: connected, autonomous, shared, and electric. This is the direction that mobility and transportation on roads and in cities seem to be taking. The amalgamation of technological progress and societal demands has powered the development of innovative transportation paradigms. The movement of

people and goods is about to change drastically thanks to shared mobility services and automated driving capabilities, which offer increased convenience, sustainability, and efficiency. However, stakeholder perceptions, requirements, and adaptability must align for these innovations to be successfully adopted and integrated.

According to an article by PWC authors Kuhnert, et al. (2018), the car of the future, is electrified, self-driving, shared, connected, and updated annually. Being electric means that it will produce less noise and exhaust fumes into the surrounding air. It moves autonomously, so you'll have more personal time and space. Since users won't need a driver's license to use it, it will be more accessible to users. It will be economical because users aren't required to pay for it immediately; instead, they can make small payments based on usage. This research focuses on the complex web of stakeholder engagement in this ever-evolving paradigm, concentrating on how acceptable shared mobility and autonomous driving options are to them, and also considering their perceptions on the BMs that will arise from them. The following sub-sections will provide a concise overview of the aspects of CASE technologies. This will help readers understand the broad areas these technologies encompass, identify the unexplored areas, and recognize the foundation they provide for companies to develop additional revenue BMs.

2.3.1 Connected vehicles and their importance in the future of mobility

Connected vehicles represent a turning point in the development of transportation by integrating vehicles into an advanced digital ecosystem. These vehicles readily integrate the Internet of Things (IoT) into their design, using connectivity for communication with external devices, infrastructure, and other vehicles. With a range of cutting-edge features, connected mobility goes beyond simple transportation to redefine the driving experience. These vehicles provide drivers with a smooth and intelligent driving experience, from enhanced safety features and personalized infotainment to real-time traffic updates and predictive maintenance. By promoting efficiency, safety, and a more integrated approach to contemporary travel, the convergence of connected vehicles with larger connected mobility initiatives seeks to create an interconnected transportation network, revolutionizing urban mobility and transportation ecosystems. Referring to research from Karmańska (2021), a connected car is a unique form of vehicle that blends information and communication technology (ICT) with automobiles. By means of vehicular communications systems, the users (driver and passengers) of this vehicle can receive, send, and share information. The Cyber Physical System (CPS) is a concept that integrates computation and physical processes. The Internet of Vehicles (IoV), which is viewed as a subclass of the Internet of Things (IoT), replaced the traditional Vehicle Adhoc Networks (VANETs). The vehicle can communicate over the Internet to accomplish targets with other objects, such as vehicle-to-pedestrian (V2P), vehicle-to-infrastructure (V2I), vehicle-to-network (V2N), and vehicle-to-everything (V2X), as well as with each other (vehicle-to-vehicle, V2V). The number of cameras, radars, ultrasonic sensors, and actuators that are built-in will likely reach 200 per car. Karmańska (2021) also states that connected vehicles generate huge amounts of data. According to Hardigree (2024), *"a typical vehicle can generate up to 30 terabytes of data every day. There are four types of data that are generated by the car: data generated by the car's internal sensors (such as speed, direction, geolocation, overall mileage, idle time, fuel consumption, route planning), data regarding nearby vehicles, data generated by infrastructure (like smart traffic lights), and data generated by peripheral devices (such as smartphones)".*

According to Nikitas, et al. (2017), connected vehicles, are poised to transform urban landscapes and the very structure of cities. They represent a paradigm shift in transportation. The arrival of Connected Vehicles signals the beginning of a revolution in transportation that will impact every aspect of urban life and change the way that smart urban growth is traditionally understood. Seen as the next big thing

in mobility, these cars are expected to open up a world of game-changing possibilities that go far beyond transportation to significantly shape cities' identities. Wide-ranging benefits are expected from connected vehicles, which could help with urgent urban issues (Nikitas, et al., 2017). The most significant of these is the possibility of a significant reduction in traffic accidents, which can be ascribed to the sophisticated safety systems and instantaneous decision-making abilities that are present in connected vehicles (Nikitas, et al., 2017). Fig 2. shows the complex framework of connected mobility design (Nakamura, 2014).

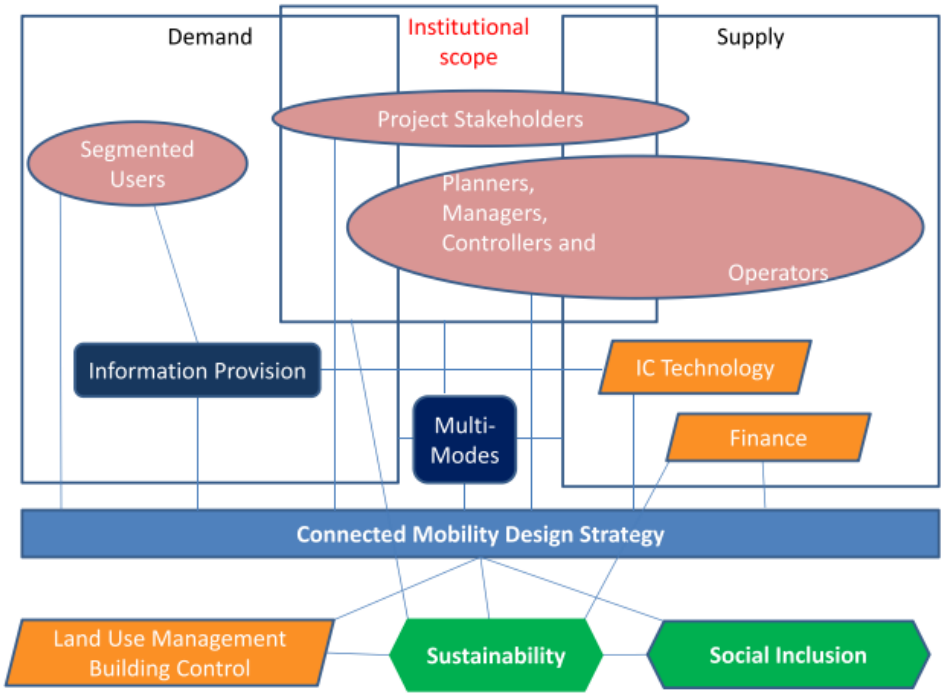


Fig. 2. A framework incorporating connected mobility design *(Nakamura, 2014)*.

Furthermore, Nakamura (2014) states that the anticipated decrease in traffic congestion is expected to alleviate urban gridlock, promoting improved mobility and smoother traffic flow. Connected vehicles provide unprecedented accessibility for underserved groups and those unable to drive, which could lessen social exclusion and increase inclusivity in urban areas. Nakamura (2014) also mentions there will be massive environmental effects because it is anticipated that connected vehicles will greatly reduce carbon emissions and noise pollution. It is projected that the switch to electric and driverless fleets will reduce environmental impact, supporting greener, more liveable cities and supporting global sustainability agendas. But even with these exciting new possibilities, the development of connected vehicles is not without its share of difficulties and potential downsides. The safety and integrity of these vehicles are at risk from potential hacking threats due to increased connectivity, raising serious concerns about cybersecurity vulnerabilities. Furthermore, reliability is at risk due to hardware and software flaws, necessitating strict quality control procedures and thorough testing guidelines (Nikitas, et al., 2017). With connected vehicles gathering enormous amounts of data and generating worries about the unauthorized use or access to sensitive information, the privacy landscape is also about to change. The allocation of liability in accidents involving AVs is a complicated and dynamic matter that requires the establishment of legal and regulatory frameworks to tackle accountability issues.

Additionally, users may experience difficulties adapting their behaviour as a result of the widespread use of connected vehicles, necessitating changes to new forms of interaction and the development of automated system trust. The lack of acceptance and adoption of connected vehicles by some user groups due to apprehensions about letting go of control or utilizing new technologies could potentially

be a barrier. From different case studies, Nakamura (2014) suggests that a multitude of interconnected elements are necessary for the formation of mobility, including different user segments, role spaces, alternative modes of transportation, policymakers, citizens, and companies involved in community problems; the transfer of information via ICT; steps taken to minimize costs through this technology; revenue equilibrium through marketing income and through partnerships with non-profit organizations; societal inclusion for those with limited incomes and transportation services; building location controls and transportation offerings; and, to name a few, the design and operation of transportation networks.. While it may not be feasible to consider every factor at all times, urban transportation strategies must maintain a clear understanding of their goals and means, recognize the significance of connections, and conduct design activities appropriately when addressing mobility.

2.3.2 Charting the future: Autonomous vehicles in CASE mobility

The development of transportation systems and urban structure are closely linked, and it is hard to separate the future transport system configuration from the vision of the cities of today. Urban form changes over the past century have been connected to a transportation revolution of sorts. The widespread use of private automobiles allowed for low-density, dispersed urban developments in the suburbs and countryside, but it also had a detrimental impact on the quality of life due to excruciating traffic jams, a lack of parking, and harmful emissions (Alessandrini, et al., 2015). AVs, also known as self-driving cars, are a game changer in transportation because they can take over the role of a driver and also communicate and coordinate in real time with other vehicles in the wider transportation network. This transformative potential originates from their capacity to synchronize and connect with multiple elements and stakeholders in the transportation ecosystem, which includes other vehicles and the road transport infrastructure. The concept of connected and autonomous vehicles (CAVs), which refers to the combination of autonomous capabilities and connectivity, is widely seen as a significant advancement in contemporary transportation (Nikitas, et al., 2017).

In the upcoming decades, if regulations allow, AVs have the potential to significantly disrupt and revolutionize ground transportation, drastically altering the current state of affairs with enormous implications for mobility, social impact, the economy, and space. The enabling technologies are developing quickly. In a business park in Rivium, Netherlands, one of the earliest AV systems has been operational since 1999. It has an 1800 m reserved track length, eight stations, six pedestrian and vehicular crossings, and six electric vehicle charging stations. With a maximum capacity of 500 passengers per hour and a headway of 2.5 minutes, the daily passenger count was 3500 (Alessandrini, et al., 2015). The combination of connected car technology and autonomous driving has great potential to usher in a time when automobiles will be able to communicate with each other and stay in real time with their environment. Through the use of linked networks, this integration allows autonomous cars to communicate with traffic management centers as well as with each other, providing access to and sharing of real-time information about traffic conditions on the roads. As a result, an ecosystem of automobiles and infrastructure is created, enhancing overall mobility experiences while also improving efficiency, safety, and comfort. The idea that CAVs, as opposed to semi-autonomous or partially connected vehicles, operate in a fully autonomous and connected state is fundamental to this paradigm shift. This differentiation highlights the capacity of these special vehicles to profoundly influence and transform the uptake of autonomous vehicle technology. This section, with a focus on CAVs, attempts to explore the impactful and promising routes for AV technology integration into the transportation future, highlighting its potential to transform urban mobility, transportation efficiency, and the safety paradigm. (Nikitas, et al., 2017).

According to a report from Future Agenda Limited (2020), there are many perspectives of how, why, and where AVs might have an impact. These areas can be split into four parts –

1) Systemic Considerations
2) Moving People
3) Goods Transportation
4) Data and Security

The report (Future Agenda Limited, 2020) also says that from the standpoint of the automobile industry, the introduction of vehicle automation is now "given," but there are still a lot of uncertainties regarding the timing and final state. The fundamental idea is that mobility can be increased for the elderly, the disabled, and other people who are currently unable to drive, in addition to automating many of the components of an ideal road trip. The current state of investment, testing, and product development for AVs—such as cars, trucks, buses, and taxis—is extraordinarily advanced. The automotive industry has never received such concentrated and intense funding, and since automation and electrification are increasingly becoming correlated, as they are for many, the potential impact is growing. Fig 3. shows the general future of AVs and the elements it could suffice (Future Agenda Limited, 2020).

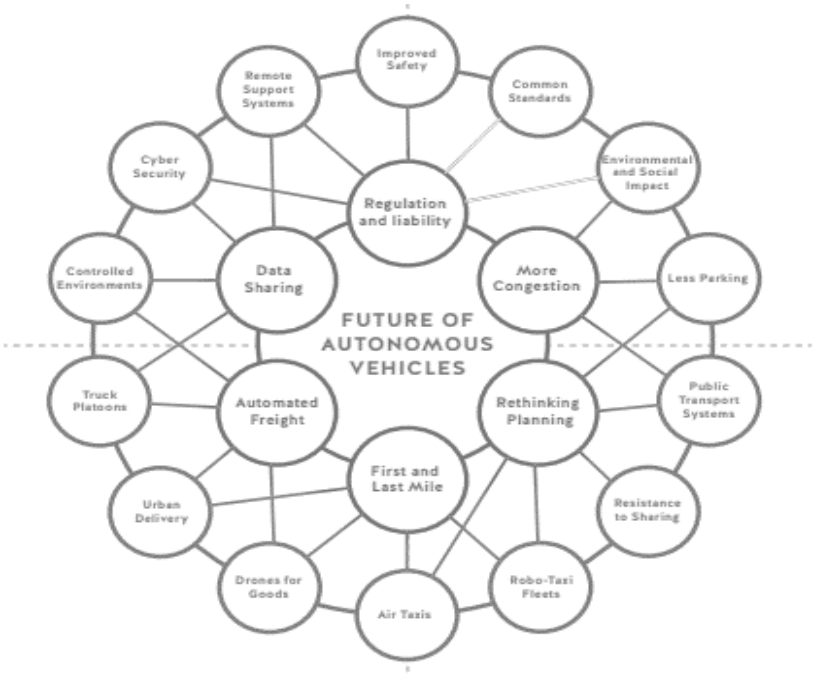


Fig. 3. The future of autonomous vehicles *(Future Agenda Limited, 2020)*

The Society of Automotive Engineers (SAE) defines six distinct automation levels (L0-L5) that range from fully manual to fully automated systems, and this is the definition of automation levels which is the most widely used in the field. The foundation of this classification system is the division of responsibilities between humans and computers, with all human responsibility falling under Level 0 and all computer responsibility falling under Level 5. Level 0 vehicles are fully traditional and require human control for all driving functions. We introduce incremental automation as we move through the levels. Driver assistance features that fall under Level 1 include adaptive cruise control and lane-keeping assistance. These features allow the car to help with certain tasks but still need constant human supervision. Level 2 denotes partial automation, in which, in certain situations, the car can simultaneously control its steering and acceleration/deceleration. Nevertheless, the driver still needs

to pay attention and take appropriate action when needed. Level 3 represents conditional automation, which allows the car to perform the majority of driving duties on its own under certain circumstances. However, the driver still needs to be prepared to take over at any time. Level 4 refers to high automation, where a human driver may be necessary in some circumstances, but the vehicle can handle the majority of driving scenarios on its own without assistance. Level 5 denotes total automation, in which the car can operate independently in any situation and is fully autonomous, negating the need for human intervention.

According to Synopsys (2022), Tesla Autopilot and Cadillac (General Motors) Super Cruise systems both qualify under Level 2 (Partial Driving Automation). Level 4 vehicles do not need human interaction in most instances and can operate in self-driving mode. An example of a company that is working on the Level 4 vehicles is Navya – a French company that is already producing and selling fully electric Level 4 shuttles and taxis in the United States, with a top speed of more than 55 mph. Another example is Alphabet's Waymo, who, following more than a year and more than 10 million miles of testing driverless cars without a safety driver in the seat, recently unveiled a Level 4 self-driving taxi service in Arizona. Magna, a Canadian automotive supplier, developed technology (MAX4) that makes Level 4 capabilities possible in both highway and urban settings. They are collaborating with Lyft to offer cutting-edge kits that equip cars with self-driving capabilities. Volvo and Baidu have partnered strategically to develop Level 4 electric vehicles (EVs) together, aimed at the Chinese robotaxi market. Some argue that the six levels should not be interpreted as a sequential deployment path, despite the fact that they are widely used and extremely helpful in discussing the various approaches to automation. It's possible that some levels—like level 3, where a human is needed for a safety fallback role—don't have a strong enough business case to be deployed (Future Agenda Limited, 2020). Fig 4. shows the levels of automation in AVs as per (Future Agenda Limited, 2020).

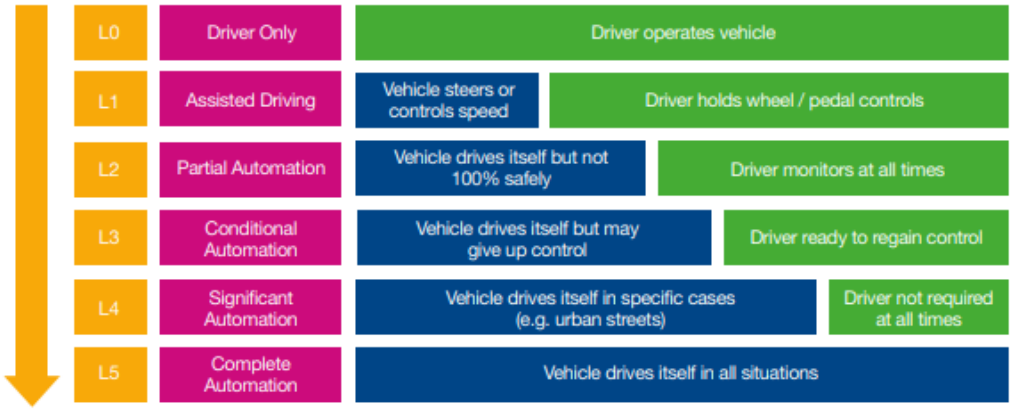


Fig. 4. The six levels of automation in AVs *(Future Agenda Limited, 2020)*

2.3.3 Shaping tomorrow's transit: Shared mobility strategies in the CASE mobility landscape

An article from McKinsey by authors Grosse-Ophoff, et al. (2017) suggests that the increasing ubiquity of shared mobility is going to have a significant impact on the direction of global vehicle sales, but not to the extent of a complete reversal. Though growth in developing markets is expected, the growing popularity of shared mobility solutions is predicted to stifle about one-third of the expected rise in vehicle sales, which is a result of rapid urbanization and macroeconomic growth. This change in consumer behaviour and preferences for modes of transportation highlights a significant change in the automotive industry, as shared mobility modifies the market structure and conventional growth projections for vehicle sales. Grosse-Ophoff, et al. (2017) also states that the story of shared mobility

does not completely portend negative outcomes for the automobile industry. There is a window of opportunity for OEMs, suppliers, and other mobility stakeholders to proactively position themselves to take advantage of the changing landscape during this revolutionary shift. Even though some of the shared mobility BMs are still in its early phases, the shared-mobility sector shows how new players are entering the market and frequently outpacing established OEMs in terms of market valuations. Around the world, the use of bike and car sharing programs has increased dramatically in recent years. Car sharing programs were in place in 27 countries as of October 2012, with an estimated 1,788,000 shares spread across 43,500 cars. Autolib is a well-known one-way car-sharing program that presently has 1800 EVs, 4,000 parking spots, and over 65,000 users in Paris (Kaspi, et al., 2014). This pattern highlights the industry's potential for expansion and innovation and shows a strong level of investor confidence and support for shared mobility initiatives. In order to stay competitive in this dynamic mobility ecosystem, established automotive companies must make a strategic shift. They must review their BMs, adjust to shifting consumer behaviour, and consider joint ventures with up-and-coming players. In a time when shared mobility is becoming a more important component of the transportation paradigm, the ability of automotive incumbents and newcomers to anticipate and adjust to these changing trends will probably determine their level of success in the future.

According to a PWC article by authors Kuhnert, et al. (2018), the mobility of the future will be characterized by behavioural changes. The variety and depth of available mobility options will significantly grow. This is already evident from the growing number of providers in this market. Innovative startups and well-established automotive, transportation, and logistics firms are competing for market share. Ride-hailing and car-sharing are two distinct examples of shared mobility. Car sharing is available in two different forms: station-based and free-floating. The vehicles' availability is the primary distinction. While vehicles can only be picked up from designated stations when using station-based car sharing, the availability of vehicles for free-floating car sharing corresponds to the supplier's business area. Ride hailing services use smartphone apps to link drivers who offer private vehicle rides to paying passengers at a fee. Transportation network companies (TNCs), create and run these internet-based platforms. The majority of TNCs operate as online marketplaces that connect independent contractors with clients, charging a commission for the introduction (Spulber, et al., 2016). This idea is becoming more and more common and is no longer considered a niche phenomenon. Global user counts are predicted to reach 338 million in 2017. Overall, there are three distinct expressions present here:

- Online car-sharing companies that establish driving communities
- Online platforms that serve as middlemen for drivers looking to arrange private vehicle trips
- Taxi businesses that use apps to provide their services

Talking about the types of mobility services, Center for Automotive Research (CAR) author Spulber, et al. (2016) states that, compared to traditional modes of transportation, NMS have been described as being more dependable, predictable, efficient, convenient, accessible, and seamlessly connected. They also provide simpler payment options. The need for parking, pollution, and traffic are all decreased by NMS, which also save consumers money on energy and transportation expenses. While each of these NMS fills a particular need, there is some overlap between them and more traditional modes of transportation. The optimal service for a particular journey is determined by the traveller’s degree of flexibility (time, destinations, etc.) and the distance of the trip. Fig. 5 gives us an understanding of the shared mobility modes as suggested by Guyader, et al., (2021).

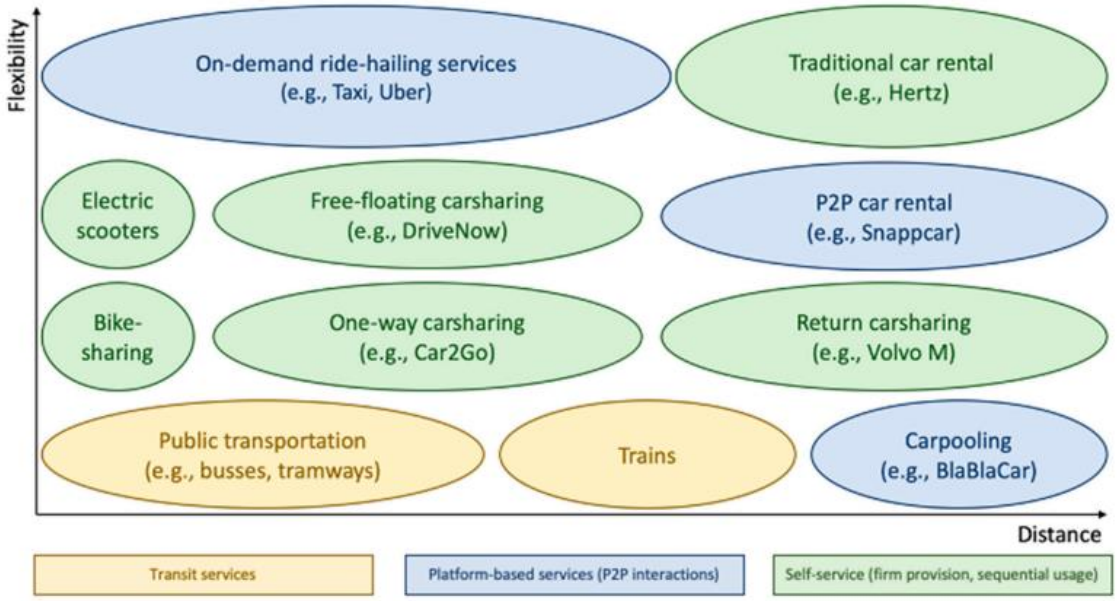


Fig. 5. Shared Mobility Modes (Guyader, et al., 2021)

Although the "sharing-economy" paradigm has been made possible by new technologies and innovations not only in the mobility sector but also in the tourism industry, it has been the sector that has grown at the fastest rate. Even though the sharing economy is expected to bring in $335 billion globally by 2025 (up from $15 billion in 2014), *"the automotive industry is just a slice of the pie."* In Europe, peer-to-peer (P2P) platforms—such as those for ride-hailing, carpooling, and car rentals—were making the most money in 2015. Specifically, the mobility sector of the sharing economy is expected to grow at a compound annual growth rate of 23% between 2013 and 2025. However, there is a long history behind these shared mobility practices. Shared vehicle use, whether concurrent or sequential, is not an unusual concept (Guyader, et al., 2021).

A large portion of shared mobility is based on public transportation, which consists of fleets of buses, trains, ferries, buildings, and rights of way that are owned by the government and offer fixed-route local and express service. Transit agencies have a lot of unrealized potential to reduce costs and increase accessibility to transportation by integrating with or providing shared modes. Large technology corporations and promising app developers are collaborating to create integration platforms that span these modes. This comes under the broader idea of MaaS which is discussed in the further sections. To get to their destination in real time, users can select from a menu of real-time transportation options, such as transit, taxi service, carsharing, or ridesharing, thanks to a number of mobile apps that are currently available on the market. Fleets of small, low-speed, human- or electric-powered personal transportation vehicles, primarily bikes and scooters, are referred to as micromobility. Micromobility is mostly found in cities, where it is employed for quick travels in places with numerous destinations and strong connectivity. When used as a first- or last-mile alternative, micromobility is quicker than walking, calling a cab, or switching to low-frequency transit. Micromobility excursions typically span one to three miles, but they can occasionally reach ten miles, particularly with the help of electric propulsion. Seldom do micromobility vehicles carry multiple passengers at once. (SUMC, 2023)

For short trips in places with strong connectivity and a high density of destinations, users can access regular ("human-powered") or electric bicycles on-demand at all hours from a network of dock-based stations or free-floating based on GPS and mobile apps. Bike-sharing systems are primarily found in urban areas. The maintenance, parking, and storage of the fleet is the responsibility of the bike-sharing service providers. Although there were only 13 bike-sharing programs in 2004 there are now many more in most major cities, initially due to government initiatives (e.g., Copenhagen City Bikes, which are coin-operated and can be accessed like shopping carts, were the first in 1995), Nextbike's dock-based system was introduced in Leipzig, Germany, in 2004, and Vélib in Paris, France, in 2007 before Autolib), and afterwards with private companies (Jump, for example, introduced its dockless system in California in 2010). Similar to P2P car rentals, P2P platforms now enable private individuals to share bikes with one another (Spinlister, for example, was established in 2011 in California). The second component of micro-mobility is e-scooter services, which rely on a geo-fenced network of electric kickbikes that users can unlock whenever they want in cities. The above data clearly indicates that, despite shared mobility services being available for nearly 20 years, there remains significant potential to further explore and adapt these offerings to meet continuously evolving customer preferences. Essentially, it functions similarly to free-floating bike or carsharing, but with e-scooters—which are more adaptable but have a shorter range. The advancements in ICT have made it possible for people to share ownership and use of automobiles. This allows people to enjoy the advantages of car ownership—such as convenience, autonomy, and independence—without having to deal with the hassles of maintenance, parking, and insurance. Rental services like Zipcar's membership program provide this opportunity. Nevertheless, the first carsharing program was a cooperative called Sefage that was established in 1948 in Switzerland. Through it, people who didn't have a car but still needed to use one could locate others in their neighbourhood and borrow their vehicle. (Guyader, et al., 2021)

Car-sharing has large benefits, including lower transportation expenses, fewer car trips, less space needed for infrastructure, and in certain situations, more convenience—all while preserving or even enhancing accessibility. When someone gives up one or more owned cars, they gain benefits. One would only pay for actual usage as opposed to the high fixed costs of car ownership, such as insurance, registration, and depreciation. For people who do not use vehicles intensively, carsharing should lower the travel costs and also the society. Car-sharing's progress has only been marginal. Just a small number of initiatives have succeeded while many have failed; none of the successful ones have reached even 1% of the market (Shaheen & Sperling, 2000). There are several reasons given, including expense, inconvenience, non-availability of cars and services, disregard for policy, and so forth. Although history should be respected, things can change. The availability and exploitation of inexpensive, user-friendly ICTs is probably going to be the single most significant change. A secondary change could be the increasing support for public policy, which could take many different forms. When consumers are unfamiliar with new products and features and when those features are still a little hazy, it is challenging to gauge demand for new technologies and features (Shaheen & Sperling, 2000).

According to Polydoropoulou et al. (2020), *“Mobility-as-a-Service (MaaS) is a user-centric, intelligent mobility management and distribution system”*. Polydoropoulou, et al. (2020) also states that through a digital interface, MaaS system integrators combine the offerings of various mobility service providers, enabling end users to conveniently plan and cover their mobility costs.. The concept of MaaS holds great potential as it seeks to provide end users with seamless mobility while also benefiting future cities in terms of economy, society, transportation, and the environment. Prototype BMs must be created in order to provide customers with high value bundled mobility services and to allow the MaaS operator and other involved actors to realize value if MaaS is to be successfully adopted by the market.

According to Sarasini & Linder (2018), the ability to design suitable BMs that can give the involved actors the required business viability while adaptably meeting the needs of the cities and end users is crucial to MaaS success. Polydoropoulou, et al. (2020) states that this understanding of the particularities of each implementation area is unique. Moreover, there are other factors that must be taken into account: (i) the present and anticipated transportation landscape of each implementation area (e.g., current or anticipated mobility services in a city, technological advancements related to transportation in the area, etc.); (ii) the actors coming from various sectors, such as the transportation and information technology (IT) sectors, and their potential partnership within MaaS; (iii) the new revenue streams and new cost structures within the MaaS scheme; and (iv) the opportunities as well as the potential barriers to MaaS implementation and how these are differentiated.

With pilot programs and associated research and development being carried out in the UK, the Netherlands, Austria, Sweden, Finland, Denmark, Australia, and Singapore, the MaaS concept is now well-known throughout the world. Funding has been provided for a number of international R&I projects in this area, including MaaSiFie, Eccentric, and MaaS4EU. (Sarasini, et al., 2018) . The CEDR Transnational Road Research Programme 2014 on Mobility & ITS is funding the MaaSiFiE project. Finding and analysing MaaS models and developing a Roadmap 2025 for MaaS in Europe are the primary goals of MAASiFiE. Ultimately, the roadmap will concentrate on improving the national road administrations' comprehension of the requirements for a widespread MaaS implementation (Eckhardt, et al., 2017). Civitas Eccentric (2016) aimed to bring sustainable mobility to communities and areas that were overlooked in urban planning and policy. Its solutions centered on the outskirts of cities. When compared to central areas, their pedestrian and cycling infrastructure, as well as public transport connectivity, are inadequate due to their intersections with urban highways and car-centric design. In order to combat this, ECCENTRIC established programs in five locations throughout Europe: Munich, Germany; Madrid, Spain; Ruse, Bulgaria; Stockholm, Sweden; and Turku, Finland. These programs brought clean transportation and urban freight to residents of these areas. The comprehensive strategy for Mobility-as-a-Service, including business models, tools, frameworks for enabling, and evidence, supports seamless mobility throughout Europe. MaaS4EU's primary objective is to address challenges under four pillars: business, end customers, technology and data, and policies. This will allow the organization to provide quantifiable evidence, frameworks, and tools to enable the MaaS concept (MaaS4EU, n.d.).

2.3.4 Electrifying transformation: Studying electric vehicles and the development of electromobility

Vehicles that run on electricity and are battery-powered are commonly referred to as EVs. Electricity, as opposed to conventional fossil fuels, is the primary distinction between EVs and conventional cars. The automotive industry has progressively escalated its research and development investments for EVs as opposed to traditional internal combustion engine-powered vehicles. Battery electric vehicles (BEVs) are the most prevalent category of electric passenger cars. Batteries that are locally contained and charged externally provide all of the power for BEVs. The degree to which an electric engine and a traditional combustion engine are combined in hybrid EVs varies amongst models. Since plug-in hybrid electric vehicles (PHEVs) can be charged directly from the grid, their primary energy source is electricity. Because they primarily rely on conventional combustion for propulsion, the remaining hybrid-electric vehicle categories (i.e., parallel, mild) are not regarded as fully electrified vehicles; electric engines are merely supplemental power sources. (Nikitas, et al., 2017).

Regarding electric mobility, the question now is "when" 100% electric will happen rather than "if" the trend will become prevalent. According to Abdelkafi, et al. (2018), the earliest engines in the history of automobiles ran on electricity stored in lead-acid batteries. When compared to internal combustion engines (ICEs) more than a century ago, the performance of EVs was inferior. As a result, the value of

EVs to the automotive sector was marginalized. Thanks to its rapid technological advancements that have boosted its competitiveness and allowed it to use renewable energies, EVs have become more and more important for mobility over the past 15 years, helping to create a more sustainable and clean future. In most countries, it is acknowledged that the most practical technological solution to decarbonize passenger transportation is the use of EVs, especially when paired with low-carbon power systems. Nevertheless, there have always been obstacles in the way of EVs being widely used. Due to government policy that has favoured fossil fuel-based vehicles as well as the routines and expectations about mobility that come with using internal combustion engine vehicles, recent research has found that EVs have a less favourable business case than petrol and diesel vehicles (Zarazua de Rubens, et al., 2020). The fact that EVs are constantly compared with conventional cars in terms of usability, style, sentiment, and driving capability is a crucial point. Because of this, numerous studies have examined the obstacles that EVs must overcome in order to be widely adopted. These studies have concentrated on various aspects or phases of the vehicle's life cycle and supply chain, as well as the ideal setup for the EV ecosystem, in particular its network of charging stations (Zarazua de Rubens, et al., 2020).

In an article by International Journal of Automotive Technology and Management (IJATM), Krommes and Schmidt (2017) talk about the characterization of the electric mobility products and services (EMPS). The article stated that there are significant differences in the electric mobility products and services provided by automobile manufacturers, mobility providers, electric utilities, ICT companies, and other market participants. BMs are typically described in the literature along the automotive industry's upstream and downstream value chains. Others describe the sale, use, maintenance, and EV as components of another economic system when referring to the products and services for EVs in relation to various (life cycle) phases. In this case, the value chain of the automobile manufacturer is the basis for the EMPS analysis, which shows how far away the automobile core business is from the prior relationship between the sales organization and its customers. Customer retention decreases with increasing distance between a product or service and the primary business, and vice versa. In other words, participation in EMPS improves customer retention to the extent that a good or service isn't related to the manufacturer's primary business. Fig.6 gives an understanding of the characterization of EMPS with respect to OEM’s core BM and its new business segment extensions, as suggested by Krommes & Schmidt (2017).

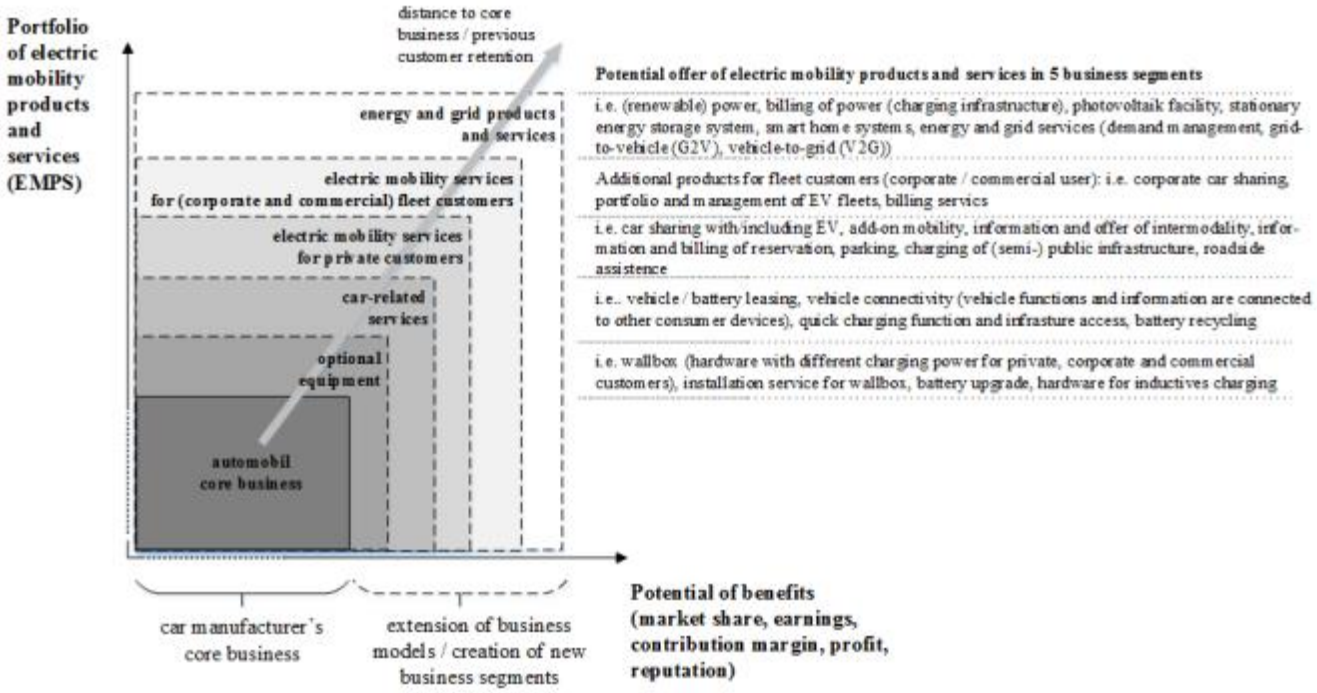


Fig. 6. Characterization of electric mobility product and services (EMPS) with respect to car manufacturer's core business model and its extension of new business segments (Krommes and Schmidt, 2017)

In the analysis (Krommes & Schmidt, 2017), the different EMPS can be classified into five categories: energy and grid products and services, optional equipment, automobile-related services, and electric mobility services for individual and fleet clients (such as corporate or commercial clients). Examples of "energy and grid products and services" include the provision of renewable energy, photovoltaic systems, stationary energy storage systems, grid services like demand management, and grid-to-vehicle (G2V). Due to the EV's limited energy storage system and the lack of a suitable private and public charging infrastructure, the business model for electric mobility products and services initially focused on overcoming the psychological and physical barriers associated with range anxiety; all pre-series pilot and research projects were interested in EV use patterns and charging infrastructure. The realization of electric mobility products and services concerning charging and electric range restrictions is now almost complete. However, efforts to overcome the limitations imposed by the electric range are still ongoing, contingent upon the product, market participants, and regional geographical developments. Current projects require significant financial and human resources in the industry and primarily focus on energy and value-added mobility services for both ICE and EVs, in addition to addressing range concerns.

Therefore, the following goals drive automobile manufacturer's participation in EMPS: (1) overcoming electric mobility barriers, (2) boosting customer retention, and (3) extending established BMs or developing new market niches. Laurischkat, et al. (2016) identified value propositions from the business model patterns which include one or more of the so-called "e-mobility key values," which list the prerequisites for utilizing EVs. In order for a customer to utilize electric mobility, six essential values must exist and can be framed as products or services. In light of this, the customer requires a value proposition that incorporates these six essential values. The key values are categorized according to their primary providers by the definition of three areas of activity. One fundamental type of technology that can be used in any field of work is ICT. For example, the key values of information and communication also cover supporting services like financing services for the payment of electricity

from various providers and navigation to find charging stations and parking spaces. While parking spaces and infrastructure for charging are assigned to the infrastructure area, companies in the mobility sector supply the electric vehicle and traction battery. And finally, an energy supplier provides electricity. Fig.7 shows E-Mobility key values as suggested by Laurischkat, et al., (2016).

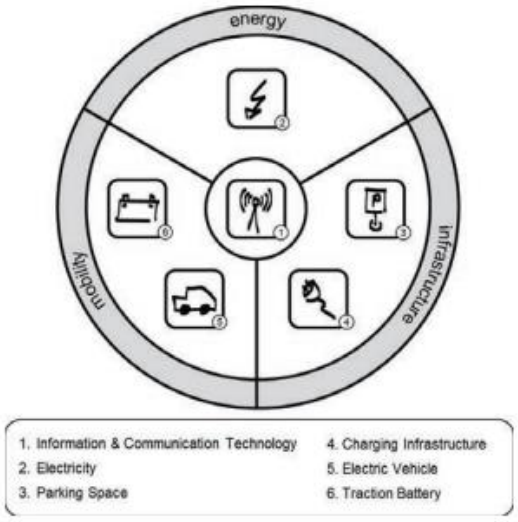


Fig. 7. E-Mobility Key Values (Laurischkat, et al., 2016)

According to Kley, et al. (2011), it is necessary to consider those components that are impacted by battery-based electric concepts, or that facilitate the removal of barriers and the subsequent adoption of EVs. Among the recognized drivers that have been covered in the general literature are the vehicle along with its battery, the infrastructure system, and the system services that allow electric cars to be integrated into the energy grid. One fundamental question to ask when thinking about new BMs is: Who owns the car or the battery? Here, it is necessary to consider traditional stakeholders like OEMs, independent traders, like banks, and the end customer. However, because of the new propulsion technology, these must now include battery manufacturers and energy supply firms, meaning that five stakeholders are involved in ownership. The so-called "after sales service" is another element that is involved in the battery and vehicle life cycle. It is crucial to identify which stakeholder in new BMs, who is in charge of battery or vehicle maintenance and repairs. Additionally, OEMs and battery manufacturers are possible players in this space. Offering these services by independent operators, like garages, or energy utilities would be an additional option. It is also possible that clients perform the required maintenance on their own.

Kley, et al. (2011) also mention the infrastructure for charging EVs, which is clarified in the second component. The various options that are presently being considered include swapping out the car's battery and using both wired (conductive) and wireless charging stations. The accessibility of the charging infrastructure can also be distinguished; for example, cars that need a wired connection can be charged at home outlets or at designated public charging stations; wireless technology can only be used partially in the private sector due to financial constraints, and battery exchanges must be managed as a public program akin to modern filling stations (Wietschel, et al., 2010). In general terms, a private, semi-public, or public connection can be distinguished. Semi-public connections are essentially restricted to authorized users, such as employees who are allowed to use their employer's private parking spaces. The fast-charging feature that is currently in place is usually highlighted in the literature or by the charging station providers. How fast the car can be recharged depends on the power supplied at the charging station in addition to the batteries and power electronics needed (Kley,

et al., 2011). The last element to consider when creating BMs is grid integration, or the opportunities this presents for providing systems services. Participants in this scenario can be one or more individuals traveling in a group of vehicles. Due to technological limitations, the number of participants affects the systems services provided. Load shifting and back-feeding power are two possible systems services that are considered. The number of kilometres driven, or the energy used by the vehicle determines how much load shifting is possible. Backfeeding energy gives systems services more flexibility in their scope (Kley, et al., 2011). Energy utilities, private individuals, and other independent operators are examples of potential systems service operators. Control over the back-feeding or charging process is required in order to provide systems services. In this case, control through a price signal is referred to as indirect control. The vehicle's battery can receive switching signals thanks to direct control (Kley, et al., 2011). Since batteries account for a significant portion of an electric vehicle's total cost, they are essential to the vehicle's economic viability. In the current debate, the battery's lifespan is regarded as being crucial above all else. Mobility options would be significantly limited and driving range would be severely restricted if battery capacity gradually dropped. Batteries that appear to be too small to be used for driving, however, may still be employed as stationary energy storage devices. Combining multiple car batteries could allow for the provision of power regulation services, or "balancing power," which would bring in additional income (Kley, et al., 2011). This would result in a higher battery residual value, which might increase the car's overall economic efficiency.

According to Bohnsack, et al. (2014), another option that is closely related to mobility concepts is battery exchange concepts. In this case, the battery is interchangeable between various vehicles while still belonging to the manufacturer. The battery and vehicle would be independent of one another in this scenario, which makes it even more challenging to create the corresponding BMs. Furthermore, a business model with more economic potential arises if the battery concept incorporates renewable energies or offers systems services. In particular, providing balancing energy appears to be a very promising solution. OEMs should reevaluate their business models for EVs and create new ones that address infrastructure problems, encourage customer purchase desire and allow sustained EV mobility. Businesses must decide whether to concentrate on products or services and how best to reach the target customer when determining the right value proposition. They have to make decisions about the value network, such as whether to manufacture or purchase EVs, how to market and maintain vehicles that have already been sold, and how to connect with suppliers and other manufacturers. Additionally, options related to the revenue/cost model are available. Due to financial constraints and technological difficulties, businesses feel compelled to offer extra services, like battery leasing that lasts after the vehicle has been purchased. (Bohnsack, et al., 2014)

Through their findings, Bohnsack, et al. (2014) divided the EV industry BMs into “luxury specific-purpose”, “luxury multi-purpose”, “economy specific-purpose”, and “economy multi-purpose” BMs. The luxury specific-purpose EV business model caters to high-income customers who purchase expensive, specially designed EVs for travel or city commuting. Notable examples are the Tesla Roadster, BMW Mini E, Audi eTron, and Chrysker (Dodge EV) which are renowned for their quick acceleration and excellent performance. Since most customers have other vehicles they use on a daily basis, this model prioritizes driving experience and brand image over range. Mobile rangers provide customer service, sales are made through upscale flagship stores, and initial production frequently entails equipping pre-existing sports cars with electric vehicle technology. Unlike the luxury specific-purpose model, the luxury multi-purpose EV business model targets the high-performance market with sedans that can accommodate more people and carry more items. Because of their increased weight, these vehicles require larger batteries or additional power sources, which raises the production costs and adds complexity. Fisker's Karma sedan serves as an excellent example of this type; it features plug-in hybrid technology but is primarily dependent on outside vendors for parts, which drives up

costs and decreases agility. The economy specific-purpose EV business model focuses on cutting initial costs through innovations like battery leasing and targets cost-conscious urban commuters and commercial customers. This model is appropriate for commercial fleets that can handle limited range and recharging, and it addresses concerns about urban sustainability. Examples include Daimler's car2go car-sharing program, which highlights a shift towards mobility services over ownership, and Think, which separated the costs of the car and the battery. With all-around electric sedans, the economy multi-purpose EV business model caters to customers on limited financial resources. It addresses issues like high initial expenses and range anxiety by offering solutions like battery leasing, government incentives, and extra revenue streams. Companies such as Nissan and GM created EVs specifically for the market, frequently contracting out battery development and providing longer warranties. In order to draw clients, technological fixes like range extenders and service improvements like fast charging and mobility packages were also used. Better Place's service-based model with fast charging and battery swapping infrastructure is one of the noteworthy initiatives. Fig. 8 shows a detailed version of the EV business model archetypes discussed by Bohnsack, et al., (2014).

Archetype	*Value proposition*		*Value network*		*Revenue & cost model*	*Examples*
	Product content	*Service content*	*Production and development*	*Sales*		
Luxury specific-purpose	- High-performance two-seater car - Delivers fast acceleration	n/a	- Refitted conventional car - Production is outsourced	- Flagship stores - Dealers	- Sales and leasing	- Tesla Roadster - Audi eTron, - Chrysler Dodge EV
Luxury multi-purpose	- High performance sedan - Additional, more complex power supply (plug-in or stronger battery) - Delivers fast acceleration, experience and is also usable as a family car	n/a	- Refitted conventional car - Production outsourced	- Flagship stores - Dealers	- Sales and leasing	- Fisker Karma
Economy specific-purpose	- Urban commuter two-seater - Promises to be sustainable and innovative	- Provides charging infrastructure - Possible car sharing option	Refitted and purpose/built, Production mostly in-house	- Internet sales / subscription	- Pay per mile - Rent battery separate from car	- car2go - Think - Mini E
Economy multi-purpose	- All-round sedan - Promises to be sustainable and innovative	- Provides battery swapping option - Offers optional conventional car for longer trips	Purpose-built, production mostly in-house	- Dealers	- Sales and leasing - Rent battery separate from car	- Nissan Leaf - GM Volt - Mitsubishi iMiev - Tesla Model S - Fisker Nina

Fig. 8. EV business model archetypes (*(Bohnsack, et al., 2014)*

Recognizing that CASE mobility and its technologies involve numerous stakeholders, the following sections will examine the key stakeholders and decision-makers in the automotive industry. This

analysis will highlight their significance and explain the criteria for selecting certain stakeholders for this research.

2.4 Understanding key stakeholders in the automotive industry

According to Bento, et al. (2015), *"Stakeholder can be defined as any group or individual who can affect or be affected by the achievement of the business objectives"*.

Nguyen, et al. (2018) state that *"Stakeholder analysis can be defined as a technique of systematically gathering and analysing both quantitative and qualitative information to determine who should be considered during the project lifecycle"*.

As mentioned by Fraga-Lamas & Fernandez-Carames (2019), the automotive ecosystem includes a broad spectrum of stakeholders, including different entities that are essential to its operation. Passengers in cars and ride-sharing services are end users, and their preferences shape market trends. While technology companies drive innovation, particularly in CAVs, car entrepreneurs contribute to the entrepreneurial landscape of the industry. Vehicle distribution is facilitated by dealers and retailers, who act as middlemen between OEMs and customers. The major producers and those who set the standards for the industry are OEMs. To provide coverage for cars and drivers, insurance companies are essential. Vehicle maintenance and customization are supported by after-market companies and independent repair shops. Regulatory frameworks are established by the government and public entities to guarantee compliance and safety. Financial institutions offer funding solutions, while telecom and technology companies contribute to the integration of advanced technologies. Sustainability issues are addressed by scrappage and recycling organizations, and research and development are supported by academic circles. The complex web of stakeholders influencing the automotive industry also includes vehicle owners and lenders, fleet managers, PTPs, and SMCs. In the automotive business, wealth is created through contracts and transactions in business networks that result in a flow of goods and services. The underlying markets could be private or public, like supply chain financing or open markets like auto auctions. Fig 9. depicts the main stakeholders in the automotive sector as per Fraga-Lamas & Fernandez-Carames (2019).

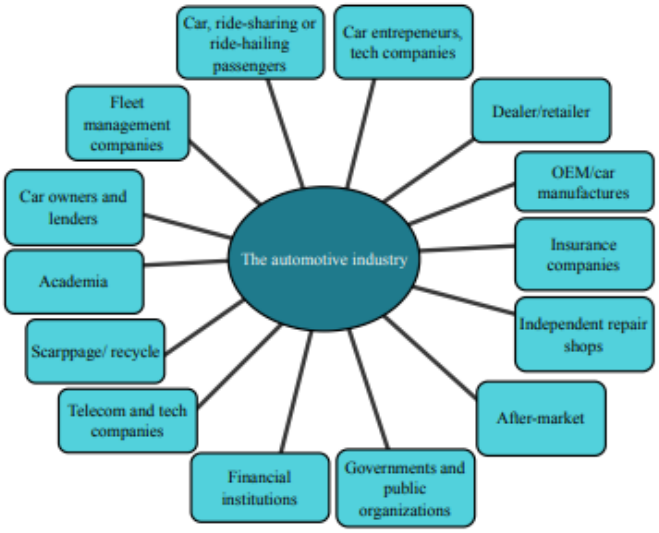


Fig. 9. Main stakeholders in the automotive industry (Fraga-Lamas and Fernandez-Carames, 2019)

This thesis strategically focuses on three key stakeholders to help navigate the complex automotive industry landscape: OEMs, PTPs, and SMs. Considering time constraints and available resources, a

decision was made to engage stakeholders and companies with established operations in Europe. Factors such as efficient communication, time zone compatibility, and existing professional networks were considered before finalizing this decision. By prioritizing accessibility and familiarity, the approach aimed to streamline collaboration efforts and leverage existing connections to maximize efficiency and effectiveness in project execution. These organizations stand out because of their significant growth potential and crucial role in influencing the direction of CASE mobility in the future. As the main manufacturers of vehicles, OEMs have an important stake in how automotive industry develops and how technology moves forward as they are the backbone of the industry. They create vehicles with innovative design and precise engineering, offering quality and dependability to government agencies, business fleets, and individual customers alike.

In the larger mobility ecosystem, PTPs are essential because they solve problems with urban transportation and support environmentally friendly transportation options. Most large cities around the world have transportation demands that can only be satisfied by a strong public transportation system. Connecting millions of people with smooth urban mobility, they prioritize affordability, accessibility, and sustainability in their operations by interconnecting networks of buses, trains, and trams (Schmöcker, et al., 2003).

Companies that provide shared mobility, best exemplified by ride- and car-sharing services, signify a dynamic shift in consumer behavior toward cooperative and on-demand mobility. As urban living evolves, SMCs take the lead in transforming transportation by offering users convenient, affordable, and eco-friendly on-demand access to automobiles, scooters, and bicycles via user-friendly mobile applications. By lowering the quantity of vehicles on the road, traffic jams, and the number of pollutants that are released into the atmosphere from cities, it can help mitigate the issues brought on by pollution and traffic jams. The quality of life, social equity, efficiency, and competitiveness of cities can all be improved by implementing shared mobility schemes (Soares Machado, et al., 2018)..

As stated by Wollschlaeger et al. (2015), opportunities regarding new BMs arise when an OEM partners with non-traditional organizations outside of their typical tier-one supply network. According to 51% of OEMs and 72% of suppliers, new BMs will present growth opportunities over the next decade. OEMs with traditionally low vehicle profit margins find the introduction of new BMs highly appealing. Moving from a one-time transactional sales model to a recurring services sales model requires a change in mindset. Furthermore, new BMs might require different thinking in terms of agility, risk, and a commitment to fail quickly rather than following the conventional business wisdom around point-project return on investment. Because of the emergence of digital technologies, the current population is living in a time of constant change, with the market and business operations in particular going through a transformation. This has a disruptive effect on how things are traditionally done, including how goods are manufactured and traded, how businesses run, and how producers and consumers benefit (Llopis-Albert, et al., 2020). The next sections will help in understanding the overall situation of the automotive industry.

3. Automotive industry: Navigating evolutionary shifts, contemporary trends, and future trajectories

The dynamic transition of the automotive ecosystem is characterized by both historical breakthroughs and modern trends. The industries have welcomed revolutionary changes, from its beginnings in mechanical engineering to the present environment that emphasizes digitalization and sustainability. Mass production scenarios from the past now collide with electrification, connectivity, and shared mobility trends, setting the stage for a future that emphasizes AVs and data-driven ecosystems. This

sector, which is at the forefront of innovation and is being shaped by changing consumer demands and technology advancements, offers both previously unheard-of opportunities and challenges.

3.1 Current status of the automotive industry

As a vital component of the European economy, the automobile industry has been essential in advancing economic expansion, encouraging innovation, and securing the prosperity of the continent for many years. According to Cornet, et al. (2023), its substantial share, which represents almost 7% of the GDP of the European Union, reflects its substantial contribution. In addition to its direct economic impact, the automobile industry is a major employer, directly employing nearly 14 million people or indirectly providing benefits to a wide range of related industries. This underscores the industry's importance as a key driver of employment and economic stability (Cornet, et al., 2023). A McKinsey article by Cornet, et al. (2023) says that the car industry is more than just a profitable sector; it has deep symbolic meaning that goes beyond financial figures. It captures the spirit of national identities and cultural pride, telling a story of European innovation and craftsmanship. Well-known slogans like "Made in Germany," which connotes quality and precision engineering, "Italian car design," which is praised for its elegance and style, "Euro NCAP for Safer Cars," which indicates a commitment to safety standards, and "British racing," which connotes a tradition of motorsport excellence, have come to symbolize the automotive prowess and inventiveness of Europe. These stories represent not only a legacy of global innovation, design, and engineering prowess, but also industrial excellence. As potent representations of European ingenuity and artistry, they enhance the continent's standing as a world leader in automotive design, technology, and production. Beyond its economic contributions, the automotive industry's cultural and symbolic significance highlights its significance as a symbol of European innovation, quality, and legacy.

According to a McKinsey article by Chiao, et al. (2024), three major development bottlenecks and considerations are regulation, technology, and consumer safety. Fig. 10 shows the key bottlenecks and considerations in the automotive industry, as per a survey by Chiao, et al. (2024).

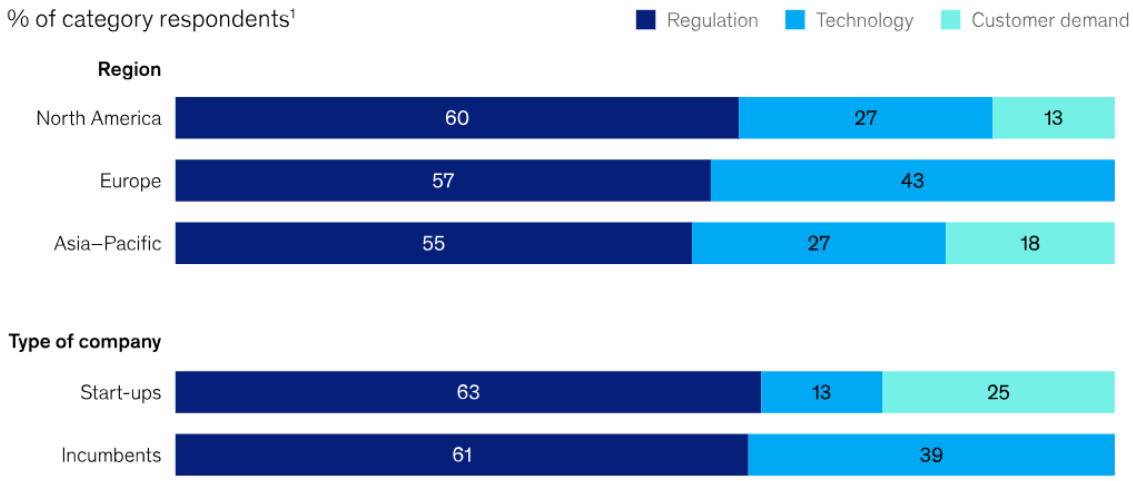


Fig. 10. Key bottlenecks and considerations for development *(Chiao, et al., 2024)*

Cornet, et al. (2023) describes the current macroeconomic environment of the European automotive industry as turbulent, with multiple ongoing crises. Europe is more vulnerable and impacted than other regions, and the automotive industry is less fortunate than other significant industries. The article also categorizes these challenges into five groups – Energy and resources, geopolitical tensions, supply

chain challenges, inflation, and productivity crisis. The next sections will cover the classic BMs and the new/emerging BMs in the automotive industry.

3.2 Classic business models within the automotive industry

According to Hylving and Selander (2012): *"The automotive manufacturing industry has a strong hardware legacy, where development processes and organizational structures are typically adjusted and reflected in the physical product, i.e. the car"*. Within the domain of product-oriented services, the automotive industry's classic BM has conventionally centred on the sale of tangible goods, predominantly automobiles. The primary source of revenue for a traditional BM is the production and sale of automobiles. In order to satisfy consumer demand, this BM focuses a strong emphasis on the distribution, manufacturing, and design of automobiles. In this BM, the number of vehicles sold drives the revenue stream primarily, and the market demand for the physical products, economies of scale, and manufacturing efficiency all play a significant role in profitability. This traditional BM coexists with more recent BMs in the automotive industry as it changes, reflecting the sector's dynamic response to shifting consumer preferences and technological advancements (Chrysakis, 2017).

According to Tukker (2004), classic BMs or product-oriented BMs are divided into two categories: 1) services linked to products and 2) advice and consultancy. Tukker (2004) states that, in this instance, the supplier provides services that are required during the product's use in addition to selling a product. This could mean, among other things, a take-back agreement in the event that the product reaches the end of its useful life as well as a maintenance contract, financing plan, or replacement parts supply. Here, the supplier also offers guidance on how to use the product most effectively in relation to what is being sold. This can involve offering guidance on the team's organizational structure or streamlining the logistics in a factory where the product is used as a production unit, for instance. Tukker (2004) also mentions that *"product-related services"* and *"advice and consultancy"*, typically yield a tangible benefit for the user through more effective utilization of resources, including labour and materials. The supplier incurs some additional expenses for materials and labour as a result. When a product-focused business implements this kind of Product Service Systems (PSS), it typically needs to invest in capital and organizational changes. Benefits could include decreased client barriers (if financial services are included), increased client loyalty, and a possible acceleration of innovation speed from improved client contacts. In the Fig.11, Chrysakis (2017) shows a basic representation of the difference between a classic/traditional business model and the digital BMs of the automotive industry.

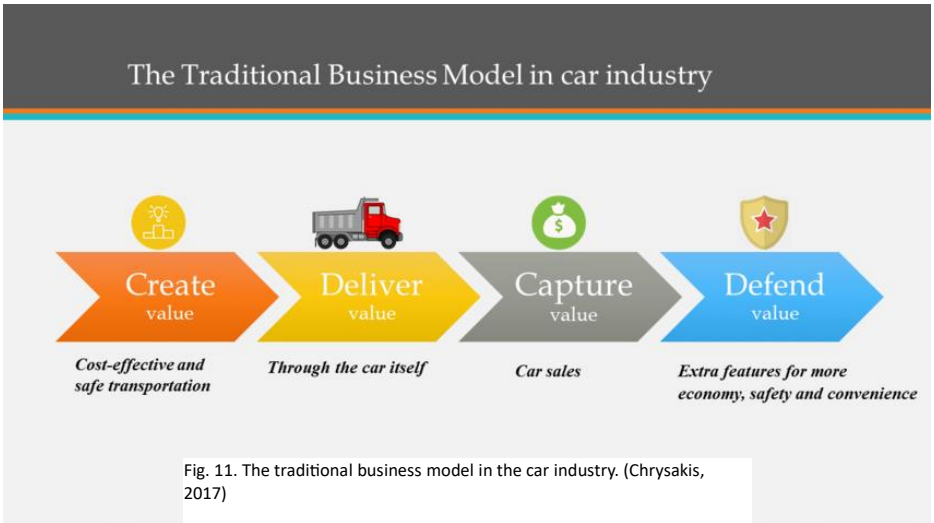


Fig. 11. The traditional business model in the car industry. (Chrysakis, 2017)

However, new BMs must be implemented to encourage manufacturers to rethink customer engagement and expectations, ensuring they maintain their value. The idea of a digital BM can provide OEMs with the desired defensive value while also giving customers access to new capabilities. Digital services that can be integrated into cars include infotainment, travel recommendations, insurance services based on driving style, tracking vehicle diagnostics, driver health services, and more. Future AVs may be able to run any kind of software on their current multimedia screens, providing excellent in-car entertainment for passengers (Chrysakis, 2017). These changes may present both opportunities and threats in the 140-year-old automotive industry, which is dominated by traditional global companies. The automotive industry may benefit from digitization in the form of new revenue streams, cost savings, and BMs. Digital technologies have the potential to become valuable assets for the automotive industry as societies adjust to demographic and environmental changes. For example, fewer people than in previous generations want to own a car, and there is growing concern about the environmental effects of fossil fuels and CO2 emissions (Oliveira & Novikau, 2022). Fig. 12 shows a digital business model in the automotive industry, as shown by Chrysakis, (2017).

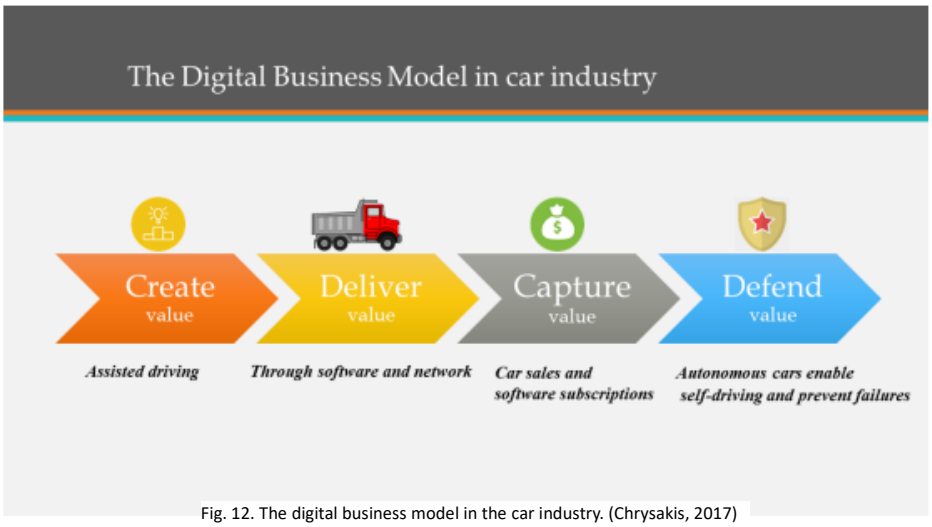


Fig. 12. The digital business model in the car industry. (Chrysakis, 2017)

The automotive industry's shift from traditional to digital BMs is driven by an awareness of a knowledge gap in the field. This acknowledgement highlights how important it is for the industry to embrace digital transformation in order to close knowledge gaps and successfully navigate the changing terrain. A strategic need to leverage knowledge, data, and technological innovations to stay competitive and meet changing consumer expectations in the digital age is driving the automotive sector's shift towards digital BMs as it adjusts to emerging technologies. According to research and interviews by Felser & Wynn (2023), six main areas of knowledge deficit were located and grouped, specifically for the German automotive market – software development, data analytics, software architecture, sourcing management, cybersecurity and IT governance, and cloud skills, platforms & ecosystems. Fig. 13 shows the knowledge deficit in the German automotive industry, from the findings by Felser & Wynn, (2023).

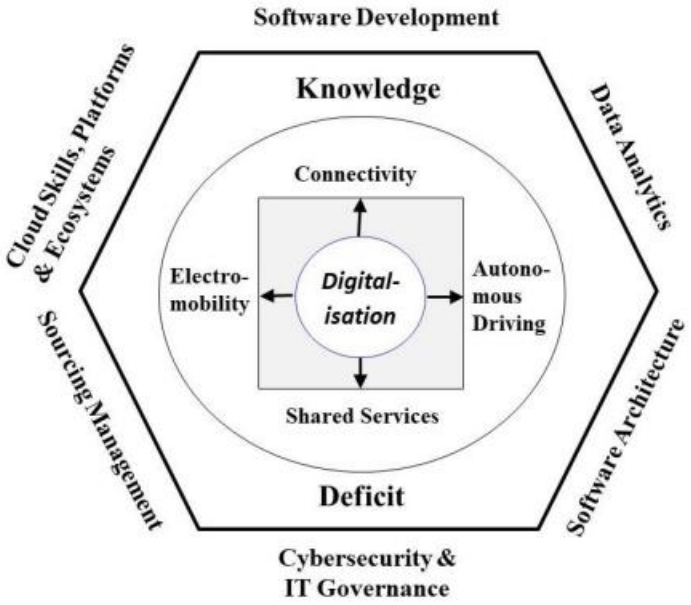


Fig. 13. The knowledge deficit in the German automotive industry (Felser and Wynn, 2023)

Companies within the automotive network must refocus their efforts towards adopting new and emerging BMs in order to ensure a seamless transition and the ongoing viability of their operations, given the recognition of the current knowledge gap. This strategic change has the potential to open up new revenue streams and opportunities in addition to being essential for addressing the challenges facing the automotive industry today. These modifications are necessary to stay in line with changing consumer preferences and attract the interest of a digitally engaged market, especially as the tech-savvy generation shows a greater affinity for smart car technology and shared services. This shift is required because it can strategically position businesses to prosper in a time of cutting-edge technologies and shifting consumer behaviour, in addition to addressing the automotive industry's pressing issues.

3.3 New/Emerging business models within the automotive industry

In the automotive sector, ancillary services and innovative strategies that go beyond the primary function of vehicles sales are referred to as new or emerging BMs. These BMs incorporate a range of strategies designed to improve customer experiences, create new sources of income, and adjust to changing consumer demands. According to an article from KPMG Global by Ball, et al. (2021), global tech giants are developing new smart car brands, and other tech startups, like ride-sharing services, are jostling for market share as well. Ball, et al. (2021) also suggests that by expanding from physical goods to software and services, traditional large OEMs are upholding their territory and competing against the new breed of competitors. They must adopt BMs that are very different from those of previous OEMs in order to achieve this. Although selling vehicles is still their primary type of business, OEMs are preparing to offer a variety of digital services as well in an effort to increasingly transform into service providers that engage directly with consumers. The focus on a new kind of value proposition, where users consume services (e.g. car sharing) rather than products (e.g. cars), is one innovative aspect of mobility service BMs. There are three main types of value propositions in this field: mobility service offerings that are multimodal, intermodal, and monomodal. A monomodal mobility service (such as ride-sharing programs and taxi services) uses just one mode of transportation to meet the needs of its users. Users of a multimodal service, such as public transportation, can choose

which mode of transportation to use to finish a trip. A multimodal (MaaS) service integrates multiple modes of transportation in a single journey, such as a car, bus, or bicycle. An additional differentiation pertains to the degree of feature integration found in MaaS BMs (Sarasini & Linder, 2018). Examples include enhancing the value proposition for customers by bundling services together such as insurance or comprehensive maintenance packages in addition to vehicle sales. Furthermore, new ideas such as vehicle subscription services or rentals offer flexible alternatives to traditional ownership, giving users access to vehicles without the obligations of full ownership. Additionally, the growing field of data monetization makes use of the abundance of data produced by connected vehicles, creating opportunities for analysis, insights, and customized services using vehicle-generated data.

Due to technological limitations, the conventional business model outlined here, which is primarily used for ICE vehicles, cannot be applied to mobility concepts based on electric drives. If innovative mobility concepts are considered, the integration of mobile energy storage into the power system or the expansion of charging infrastructure, then it is inevitable that there will be advancements in the value chain, the revenue model, and the value proposition (Kley, et al., 2011). According to Tukker (2004), there are three primary types of BMs that appear in the literature already in existence in a similar or identical form. These three fundamental categories fall in between providing only a product and providing only a service. When these are used in conjunction with mobility, the end user has two options. They have the option to purchase the product in the form of a vehicle or purely the service in from of shared mobility. This has introduced a number of ways to offer mobility services to the end customer (Kley, et al., 2011). Fig. 14 shows how BMs are differentiated based on if they are product-based or service-based (Tukker, 2004).

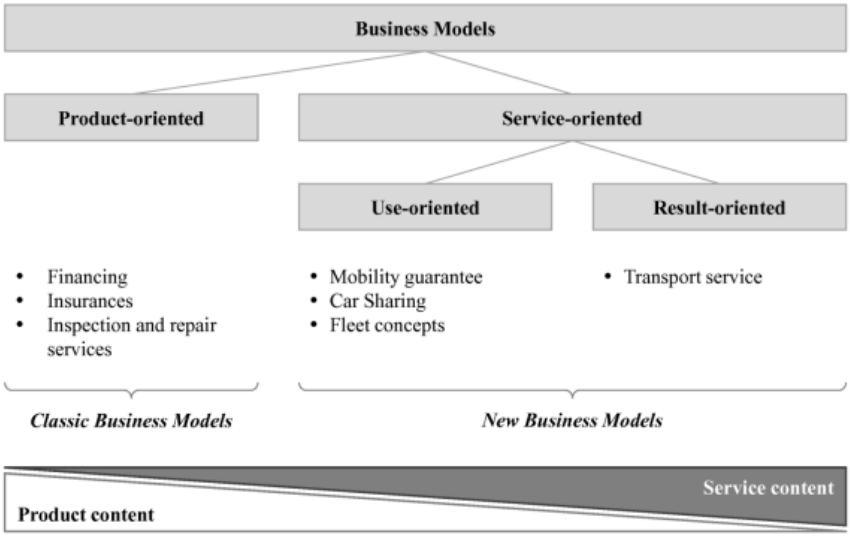


Fig. 14. Tukker's typology (Tukker, 2004)

In the typology by Tukker (2004), the first category describes the “product-oriented business model”. Here, the OEMs offer additional services to the main product. The manufacturer’s primary focus remains on its core offering, and services are seen only as supportive tools to boost sales and strengthen customer retention. Financing, insurance, maintenance, and repair services are some of the typical offerings in product-oriented BMs. On the other hand, categories two and three—also referred to as "service-oriented BMs"—are applied during the vehicle's service period and are characterized as new or innovative BMs due to their novelty and limited distribution. The terms "use-oriented" and "result-oriented" can be used to further categorize service-oriented BMs. Put differently, the emphasis is now on a contractually guaranteed performance that continues after delivery rather

than the core product. When this idea is applied to mobility offers for use-oriented BMs, it implies that the purchase of a vehicle carries a promise of a specific value. For battery-powered EVs, this includes fleet concepts, car-sharing initiatives, and mobility guarantees, among other programs that ensure the availability of automobiles or mobility services without requiring the customer to actually own a car. In contrast, for result-oriented BMs, this implies that the mobility provider will always be able to assist the end user in getting from point A to point B. Although the customer does not own a car, he is guaranteed the ability to travel a specific distance whenever he pleases. This would be the situation, for instance, if transportation services were provided. Unlike the traditional taxi concept, this one is provided by the vehicle manufacturer; no other service provider is required (Markeset & Kumar, 2005). According to Genzlinger, et al. (2013), a revolutionary wave of digitalization has swept across industries as a result of the widespread integration of new technologies, spurring the emergence of innovative services and game-changing BMs.

Servitization: Linking Customer-Centric Services and Products Together

The idea of servitization is a significant development, defined by the deliberate move towards creating technology-driven BMs that give priority to the provision of knowledge-based services for the whole life of manufactured goods. Servitization is essentially a shift away from conventional product-centric methods and toward a service-oriented perspective. It places a strong emphasis on using technology and data-driven insights to provide services with value added that go beyond the simple selling of goods. (Genzlinger, et al., 2020)

According to Kindström (2010), the term "servitization" refers to the process by which businesses are adding services to their existing product offerings or creating new ones in which products are not the primary focus of the business model or value proposition. Genzlinger, et al. (2020) mentions that this change reinterprets the manufacturer-customer relationship as a comprehensive, continuous interaction spanning the whole product life cycle, rather than just a transactional exchange of goods. The core of servitization is the conversion of manufacturing organizations into suppliers of complete, customized solutions. According to Shin, et al. (2022), in order to obtain data and insights from products that are being used in real time, it entails integrating digital technologies, IoT sensors, AI, and analytics. By using this data, producers can provide services for performance optimization, remote diagnostics, predictive maintenance, and customized customer support all the way through the lifecycle of the product. 'Outcomes' are now offered by manufacturers instead of just products, and this shift goes beyond the first sale. For example, a manufacturer using servitization might provide a "power-by-the-hour" service, guaranteeing optimal performance and availability of the equipment for the duration of its operational life, rather than just selling a piece of machinery. This strategic change promotes long-term relationships, recurring revenue streams, and competitive differentiation in the market in addition to improving customer satisfaction (Genzlinger, et al., 2013). Prominent companies in every industry enhance their product offerings by introducing innovative services, which in turn boosts customer value, elevates brand preferences, and develops integrated solutions that increase opportunities for cross-selling. This type of service innovation is commonly known as "servitization," which is the capacity of a manufacturer to provide product-service solutions tailored to the needs of a particular customer base or industry. This is achieved through a close relationship between the manufacturer and the customer (Shin, et al., 2022). According to Genzlinger, et al. (2020) , BMW has shifted its strategy to a more comprehensive customer-centric approach by expanding its product offerings to include services like leasing, car-sharing, and vehicle rentals. This evolution places BMW as a mobility service provider rather than just a car manufacturer, going beyond the conventional notion of automotive manufacturing. BMW leverages changing consumer preferences for flexible mobility solutions and experiences beyond car ownership by expanding its portfolio with these

services. Alstom, IBM, and Rolls-Royce are manufacturing industry leaders when it comes to effective servitization tactics. IBM has moved from being a hardware vendor to a provider of integrated solutions and services, utilizing its knowledge of AI, cloud computing, and analytics to provide all-encompassing business solutions. Once known for its engineering in the fields of aerospace and marine, Rolls-Royce has now branched out into offering 'power-by-the-hour' services, guaranteeing optimal performance and upkeep of its engines, and delivering results rather than just products. Alstom, a prominent player in the rail transportation sector, has broadened the scope of its services to include integrated mobility solutions, which include upkeep, modernization, and operational assistance, with the aim of cultivating enduring relationships with customers (Kowalkowski, et al., 2017) .The effective adoption of servitization by these businesses highlights a deliberate move away from conventional product-centric models and toward customer-centric, service-oriented methodologies. These businesses meet changing market demands, establish recurring revenue streams, strengthen client relationships, and gain competitive edge in their respective markets by fusing services with their core offerings. Their capacity to innovate and modify business plans in response to shifting client needs is an example of servitization's transformative potential and strategic significance in today's manufacturing environments. Fig. 15 shows a six-step approach integrating services successfully (Kryvinska, et al., 2015).

1	Identify which Products to Cover	- Support all products - Support only complementary products - Support even competing products
2	Create a Portfolio of Service Products	- Too few or too many service products reduce quality levels and profits - Separate through different performance levels
3	Select Business Models to support Service Products	- Establish funding mechanism to make aware of service value - Apply different models for different products and life cycle stages
4	Modify after-sales organizational Structures	- Employee management through additional recruiting and trainings - Consider outsourcing of service units to third-parties
5	Design and manage after-sales Services Supply Chain	- Match supply of resources with demand - Deliver right materials, through right people, with appropriate infrastructure, at the right place, within an agreed-upon time at the lowest price
6	Monitor Performance continuously	- Deeply understand customer problems and perceptions - Evaluate performance against benchmarks

Fig. 15 Six Step Framework for Successful Services Integration (Kryvinska, et al., 2015)

According to a journal article by Wiprächtiger et al. (2019), BMs are vital to the success of profit-driven private companies, but they are also very important to non-profits, governmental organizations, and social enterprises that are not considered businesses in the traditional sense. Non-profit organizations nevertheless generate revenue, offer services, and raise funds for events even though they are not making a profit for their owners and investors. In the same way, taxes, fees, and service revenues fund government organizations. In addition, they have a fee schedule for the services they offer, and the people hold them responsible for social system improvements and economic growth. Wiprächtiger et al. (2019) also states that the idea of BMs may not be as clearly defined or understood in the public sector as it is in the private sector and organizations must, nevertheless, adopt strategic frameworks that effectively sustain and propel their operations within their particular contexts, regardless of

whether they operate in the public or private sector, pursue social or economic goals, or function in a variety of markets.

The nature of BMs for organizations in the public sector is frequently implicit and embedded in the larger framework of organizational strategies and objectives. Even though the language may be different, the fundamental principles are still the same: value creation, efficient use of resources, and compliance with laws or regulations. Even though these organizations may not refer to what they do as "BMs," they always face comparable difficulties when it comes to maximizing resources, involving stakeholders, and attaining sustainability in their operational frameworks. These organizations, whether providing social welfare, public services, or pursuing economic goals, need to adopt strategic frameworks that are in line with their particular contexts. These frameworks could include methods for allocating resources, mechanisms for providing services, collaborations with stakeholders, and strategies for generating income, all specifically designed to meet the diverse requirements and needs of the communities they serve. Furthermore, these public entities' operational strategies and approaches are greatly influenced by the context in which they operate, whether in developed, emerging, or frontier markets. Flexible and context-specific BMs are required due to the variety of markets and the differing levels of social, economic, and infrastructure development. Organizations operating in developed markets may prioritize innovation and service diversification, whereas those operating in emerging markets may concentrate on infrastructure development and capacity building. Essentially, although the language and explicit acknowledgement of "BMs" may vary in the public sector, the core ideas of resource management, stakeholder involvement, strategic planning, and sustainability are still essential (Wiprächtiger, et al., 2019).

According to an article by Kindström (2010), companies are expanding their business with new offerings that contain a relatively high degree of service content due to decreased sales margins caused by commoditization and competition in their traditional product sectors, including from low-cost actors. They may be able to expand their market reach by diversifying into services, as traditional product markets are quickly becoming saturated. Kindström (2010) states that, for instance, truck manufacturers like Toyota Materials Handling are focusing on new revenue models based on different types of rental agreements rather than just selling warehouse trucks. These models require them to invest in financing as well as in service and maintenance. Service-based BMs are on a rise due to its flexibility and convenience. According to Wirtz & Ehret (2013), when internal operations are replaced by externally sourced services, there is often a significant shift that occurs, such as the creation of an organizational interface that defines the relationship between the company (which is now the client) and its external service provider. This is similar to the outsourcing of support services. The division of labour between the client and the service provider is the fundamental event that has changed a manufacturing support activity into a true service process. The primary distinction is that an independent firm has been entrusted with managing the client's assets, procedures, accountability, and control. This is in line with a line of service research that maintains that services add value by relieving customers of the expenses and burdens associated with ownership. For instance, you can either purchase or rent an automobile to enable yourself to use one. The first example would be classified as a goods business and the second as a service business by most economic statistics. The transfer of ownership rights is the primary distinction between transactions that are service-centered and those that are goods-centered. This means that, unlike exchanging goods for cash, services are just transactions in which ownership rights are not transferred. Accordingly, services are an answer to the fact that ownership entails expenses, liabilities, and responsibilities that may outweigh the advantages for its holders. Owning a car exposes you to fluctuations in the market value and location of the vehicle. These features make car-ownership unattractive for the occasional intercontinental

business or holiday trip, but much more attractive for frequent commuting or spontaneous rural escapes (Vargo & Lusch, 2004).

Given the wide-ranging landscape of new BMs in the automotive sector, this study deliberately concentrates on exploring the complex dynamics of two major trends: vehicle subscription services and data monetization models. The choice of these particular trends is the result of a careful investigation meant to reveal the distinctive traits, challenges, and consequences that these BMs offer. Focusing on these two particular trends, the study seeks to offer a thorough grasp of their significance, explaining why they stand out from the multitude of innovative BMs that are presently reshaping the sector. In case of vehicle subscription services, customers can choose from a range of vehicles without having to commit to long-term ownership, which is a break from traditional ownership structures. These services offer a dynamic and flexible approach to vehicle usage in response to the changing preferences of contemporary consumers who prioritize flexibility and experience over long-term ownership. According to a journal article by Szamatowicz & Paundra (2019), the sharing economy model of accessibility, which differs from other access-based services like carsharing and ridesharing in terms of the duration of access (monthly vs. minutes), is reportedly receiving more attention with the emergence of vehicle subscription services (month-to-month car services). Subscription services are more like leasing, but they allow you to swap or return cars quickly while the contract is still in effect. As a result, users of the service can benefit from car ownership without having to worry about the expense of doing so. Car subscription services allow for a greater degree of personalization than ridesharing and car sharing because the car is exclusively used by the subscriber during the subscription period. As stated by Paundra et al. (2017), the economic principle of sharing the use of underutilized assets is the foundation for many shared products and services. By utilizing the latent value of assets that would otherwise go underutilized, this novel approach promotes a more sustainable and effective use of resources. This idea encourages shared access over individual ownership, which not only maximizes asset utilization but also advances a more economically and environmentally sustainable model through cooperative consumption platforms and shared mobility solutions. These services, which are often associated with the development of connectivity and technology, utilize digital platforms to simplify the subscription process and enable users to easily manage their vehicle usage.

On the other hand, data monetization models are also an emerging research area for top automotive firms. Utilizing the data produced by automobiles opens up new revenue streams, turning the car into a useful informational resource and generating chances for further monetization after the initial sale. According to a conference paper (Sterk, et al., 2022), the automotive industry's recent big thing is the connected car. Without a doubt, this megatrend will influence how mobility develops in the future, bringing high-value services to fleet owners and drivers. As stated by Sterk, et al. (2022), a single modern vehicle generates an exponential amount of data. The question of how to profit from this priceless data is thus one that the entire global automotive industry must answer. Data-driven BMs, spurred by the trend toward connectivity, are upending the automotive ecosystem through new strategic partnerships, mobility behaviour changes, and revenue stream shifts. Even though such vehicle data is only currently used for vehicle functionality and safety, it can help develop new information systems (IS) for drivers and other stakeholders, such as insurers, meteorologists, and city planners, even outside the automotive industry (Sterk, et al., 2022). Data monetization can only be possible if businesses address the EU Data Act and its guidelines. The main objectives of the EU Data Act (European Commission, 2024) are to increase legal certainty for both businesses and individuals, encourage data sharing across industries and with the public sector, and establish precise guidelines for data usage rights. It attends to data portability, making sure customers can easily move their data between various service providers. Additionally, the act emphasizes data security and privacy, making

sure that data sharing complies with current GDPR regulations and protecting people's personal information. In order to foster competition and transparency, it highlights how important it is for businesses to make sure that vehicle data is available to users as well as third parties. The act specifically requires that vehicle owners and approved service providers have access to data produced by vehicles, including performance metrics, maintenance logs, and usage patterns. Future connected vehicles will interact extensively with digital infrastructure, ecosystems of automotive data (which may be generated by other road users' digital devices), and data provided by other services (Kaiser, et al., 2018). The potential for monetizing vehicle-generated data is highlighted by the growing industry reliance on data-driven insights, adding a new facet to the conventional BM. The emergence of IoT technologies and connected cars has made it possible to collect and use the enormous amount of data produced by automobiles, opening up new revenue streams for analytics and insights.

For the primary research, the author has chosen to focus on vehicle subscription services and data monetization models because of their unexplored aspects and dimensions. Subscription services for vehicles and data monetization strategies raise concerns about data ownership, privacy, and regulatory compliance. The uncharted area is figuring out how to ensure ethical and responsible business practices while navigating the changing legal landscape. It is necessary to investigate the degree of consumer awareness and market penetration regarding the complexities and advantages of these models. It is essential to know how well these models are interpreted and received by various consumer groups. It is an unknown territory to investigate how these BMs mesh with cutting edge technologies like blockchain, AI, and autonomous driving. The breadth is in realizing the opportunities and possible setbacks that these developing technologies may present. There is still more research to be done on the sustainability and environmental effects of car subscription services and data monetization strategies. This entails being aware of the subscription vehicle life cycle and the effects that increased data use will have on the environment. A promising area of research is looking at the larger ecosystem and how these models work with other players in the tech and automotive industries, like OEMs, service providers, and data analytics companies. These BMs, as integral components, find their place under the expansive umbrella of Mobility-as-a-Service (MaaS) (Callegati, et al., 2017). MaaS is a paradigm-shifting approach to transportation that prioritizes the smooth fusion of diverse mobility services onto a single, user-focused platform. Chapter 4 will explore MaaS in more detail, with an emphasis on how emerging BMs—like vehicle subscription models and data monetization models—advance the field. These models not only challenge established ideas about who owns a car and how to use data, but they also have a significant impact on how connected and sustainable mobility solutions will develop in the future.

4. Into the future: Navigating Mobility as a Service (MaaS)

In order to get around some of the present drawbacks of the conventional sales model, OEMs have begun offering new MaaS BMs. It was primarily because traditional sales had an average profitability of only 2% that OEMs looked for new services to boost profits (Smania, et al., 2023). As stated by MaaS Alliance (2016),*" Mobility-as-a-Service (MaaS) integrates various forms of transport and transport-related services into a single, comprehensive, and on-demand mobility service. MaaS offers end-users the added value of accessing mobility through a single application and a single payment channel (instead of multiple ticketing and payment operations)".* According to Giesecke, et al., (2016), MaaS stands out among the alternatives for managing such increased mobility in two ways. First, there's an inherent chance that MaaS will reduce the usage of private vehicles. The majority of CO2 emissions originate from private vehicles, many of which are driven by a single passenger. On the other hand,

there are two primary reasons why a shared or rental car emits less CO2: (1) these types of vehicles are typically newer and therefore emit less pollution than the average vehicle fleet; and (2) the average occupancy rate of a passenger car used for urban trips is typically between 1.20 and 1.90 people (e.g. 2,2 in France, 2,5 in UK) (MaaS Alliance, 2023). However, in the future, if MaaS is implemented on a large scale, it will reduce transportation costs, possibly leading to more kilometres travelled. This could lead to increase in emissions but can be contained by the adoption of AVs and EVs.

Second, MaaS permits the transportation of both people and cargo in the same vehicle, at least conceptually. A well-run MaaS service also introduces new ways to organise and run the different transport options. This benefits transport operators by giving them access to better user and demand data as well as new ways to meet unmet needs. MaaS seeks to offer a less expensive, potentially even more convenient, environmentally friendly, and aiding in the reduction of traffic and transportation capacity substitute for driving a private vehicle (MaaS Alliance, 2016). Therefore, MaaS has the potential to be a more environmentally friendly mode of individual transportation than anything other than walking or bicycling. According to Sarasini & Linder (2018), MaaS can increase vehicle occupancy and improve resource utilisation rates while utilizing the current fleet of vehicles to produce sustainable results. MaaS must, however, increasingly make use of vehicle technologies like biofuels, fuel cells, hybrid, and electric drives, as well as autonomous and linked vehicle technologies, in a way that can further minimize environmental impacts. This is true for the entire transportation system. Fig. 16 shows a three arrow diagram for MaaS (Sosi, 2020).

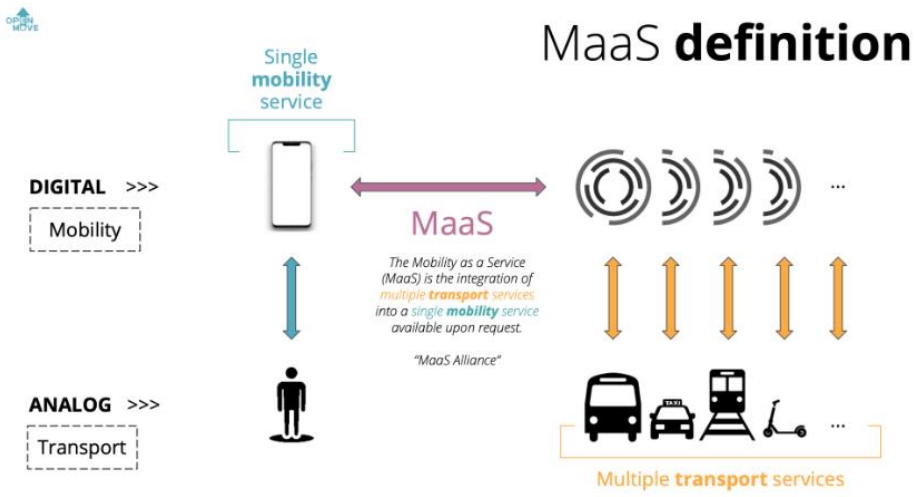


Fig. 16. Three arrow diagram for MaaS (Sosi, 2020)

According to Sosi (2020), the blue vertical arrow represents 'digitalization of travellers'. The user is inexpensively, efficiently, and dependably digitized. The majority of the user's digitization (device and connection) is provided by him, and it is sufficient to give the individual the software tool required to complete this process. The yellow vertical arrows represent 'digitalization of transport services'. Historically, the digitization of transportation services (and thus, the mobility offer) began earlier than the demand (for instance, fleet management before smartphones), but it has grown more slowly and is currently lagging behind. It is no coincidence that one of the primary obstacles to mobility innovation is the widespread obsolescence of the technologies used in the transportation industry today. The pink horizontal arrow represents 'demand and supply matching in the digital dimension'. This is the point at which the exquisite digital meeting of supply and demand creates new opportunities. The accurate and efficient digitization of supply and demand forms the foundation of the digital meeting.

4.1 Scope of MaaS

The size of the global MaaS market is estimated to be USD 5.7 billion in 2023 and is projected to grow at a compound annual growth rate (CAGR) of 32.2% to reach USD 40.1 billion by 2030. MaaS provides a solution by giving users access to multimodal transportation options, which in turn reduces the number of private vehicles on the road and alleviates traffic congestion. As a result of the rapid urbanization that is occurring, traffic congestion and related challenges are growing. These services are typically very customizable and adaptable to each individual user. The need for seamless MaaS applications for end-to-end multimodal transport solutions will be fuelled by factors such as falling vehicle ownership, faster internet connectivity, and the need to lessen traffic congestion and vehicular emissions. Fig. 17 uses a graphical approach to show the global MaaS market. (marketsandmarkets, 2023).

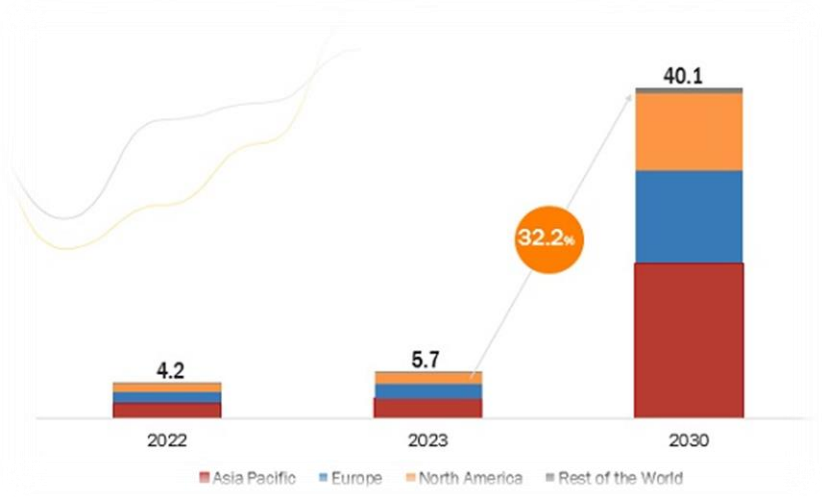


Fig. 17 - Mobility as a Service Market Global Forecast to 2030 (USD Billion) *(marketsandmarkets, 2023)*

As per Goodall, et al. (2017), over the past ten years, consumers have embraced new mobility options and apps more and more. Carsharing is expected to have more than 23 million members worldwide by 2024, having increased from about 350,000 in 2006. As of 2014, there were almost 5 million members worldwide. More than 50 countries have more than 1,000 public bikeshare programs; in 2004, only 11 cities globally had such initiatives. Ride-hailing services have expanded at a similarly quick pace. After just six years of business, Uber has more than 500 locations across more than 70 countries. With local and international options available in every city, journey planning apps, which assist users in identifying and comparing various modal options for getting to their destinations, have become ubiquitous. The next logical step would be to combine all of these choices onto one platform. This would allow for the planning of trips using a variety of modes of transportation, with flexible payment options and customization according to user preferences for cost, comfort, convenience, and/or time. With so many more options, clients ought to be able to conveniently arrange and pay for a variety of services while traveling.

4.2 The benefits of MaaS

In addition to lowering the number of individual cars owned and reducing traffic, the approach taken by MaaS encourages sustainable mobility practices. MaaS optimizes public transit networks, promotes a move toward environmentally friendly options, and helps make better use of available resources. It also gives users access to real-time information, customized trip planning, and simplified payment

methods, all of which improve the accessibility and overall effectiveness of urban mobility. Maas Alliance (2023) also introduces a 'virtuous cycle for MaaS' for lowering a city's dependency on private vehicles. This model is predicated on the idea that individuals will choose the mode of transportation they believe to be the best option for their intended destination. Cost, comfort, convenience, flexibility, dependability, and shortened travel time are among the factors that are considered. The way in which transportation policies affect the modes that people use most interests people. Voter-pleasing policies and investments are given top priority by politicians. MaaS needs top-notch component services as a base. People must have faith that there will always be a cost-effective substitute for owning a car when it comes to making this decision. Individuals who don't own cars are less likely to drive. CO2 emissions can be reduced by using fewer cars in the transportation system, though this is also reliant on users choosing shared transportation options. Fig. 18 shows how MaaS implementation can lead to reduced carbon emissions (MaaS Alliance, 2023).

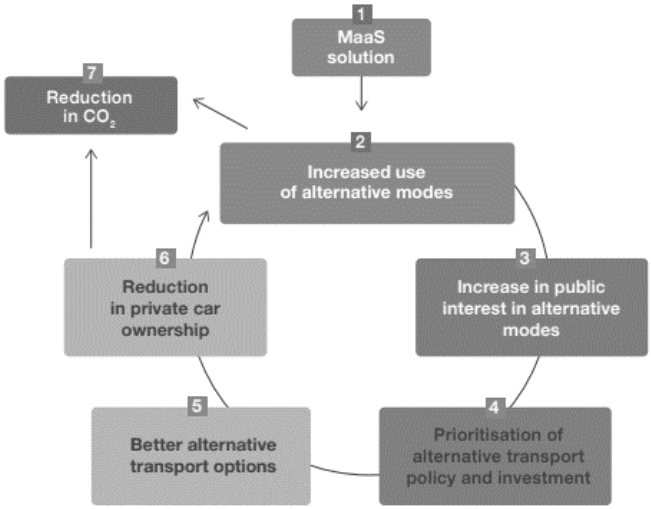


Fig. 18. Virtuous cycle for MaaS leading to reduced carbon emissions (MaaS Alliance, 2023)

4.3 Implementing MaaS

Collaboration between public and private stakeholders is required for implementation, and digital technologies are used to build an integrated and accessible transportation ecosystem that improves end users' convenience and productivity. According to Polydoropoulou et al. (2020), in order to implement MaaS, a number of transportation modes and services must be combined, including traditional transportation options like public transportation, taxis, and car rentals, as well as newer transportation options like AVs, ride-hailing, carpooling, and bike- and car-sharing. Additionally, some essential components like booking, ticketing, and multimodal traveller information services must be integrated. A number of factors must be considered and resolved in order to enable cities to shift from their current mobility towards MaaS. The most crucial of these is ensuring business viability while also satisfying operational and technical requirements. Polydoropoulou et al. (2020) also talks about other factors that must be taken into account, and they are: (i) the current and anticipated transportation landscape of each implementation area (e.g., mobility services that are offered or planned in a city, technological advancements related to transportation in the area, etc.); (ii) the actors that come from different sectors, such as the IT and transportation sectors, and their potential collaboration within MaaS; (iii) the new revenue streams and cost structures within the MaaS scheme; and (iv) the opportunities as well as the potential obstacles to MaaS implementation and how these are differentiated. MaaS, which is essentially a technology-enabled Mobility Management service, is greatly aided by technology. This is an important finding, as Mobility Management is a fairly well-

known and established concept. A successful MaaS implementation is likely to be influenced by a number of factors in addition to technology, such as the following: the broad availability of contemporary digital solutions that enable the demand for and delivery of mobility options in time windows that were previously unattainable; access to open data (such as timetables, real-time location information, and user-generated content); the availability of interoperable payment systems from transport service providers (such as taxis, trains, local transport operators, and car sharing); regulatory reform to allow for mixed-mode opportunities; and the capacity to provide scalable solutions (Wright, et al., 2020).

4.4 MaaS drivers and barriers

MaaS has the potential to completely transform how people travel in the current era of transportation. However, a complex interplay of barriers and drivers affects MaaS's widespread adoption. These variables cover a broad spectrum of technological, socioeconomic, and regulatory facets that influence how MaaS adoption and implementation proceed. In order to create strategies that effectively encourage the adoption of MaaS solutions and realize their full potential in revolutionizing urban mobility, it is imperative to comprehend these drivers and barriers. Based on various socioeconomic covariates, a study by Alonso-González et al. (2020) divides people into five cluster groups: MaaS-FLEXI-ready individuals, Mobility neutrals, Technological car-lovers, anti-new-mobility individuals, and Multimodal public transport supporters. This study identified variables such as bike frequency use, bike sharing awareness, car ownership, users of public transportation, frequency of car use, etc. based on travel patterns. When the primary factors influencing a person's decision to use public transportation were examined, a variety of options emerged, including ease of use, relaxation, time, safety, adaptability, joy, status, dependability, affordability, environment, ownership, health, and carrying capacity. Given that many people (primarily those over 60) lack a smartphone or a 3G connection, technological features are also crucial to the widespread adoption of MaaS. From a broader angle, there are a few things that prevent MaaS from being widely used. Strong sense of ownership, a lack of technological adoption, and a lack of awareness of the environment and finances have all been identified in the literature as significant factors that prevent people from adopting new mobility solutions and moving away from a car-centric lifestyle. Moreover, the study also says that the views of individuals regarding other mobility options are significantly shaped by cultural norms and societal perceptions. The perception of status and convenience that come with owning a personal vehicle, along with the deeply ingrained preference for car ownership, pose a significant obstacle to the adoption of new mobility solutions. The resistance to embracing alternate forms of transportation is also influenced by the lack of a thorough infrastructure to facilitate multimodal transportation and the perceived complexity of navigating diverse mobility options contribute to inertia in adopting alternative modes of travel. A comprehensive strategy that includes focused awareness campaigns, infrastructure investments, and policy interventions meant to encourage sustainable mobility choices is needed to address these complex obstacles. Stakeholders can create a more sustainable and inclusive urban mobility ecosystem by tackling these issues.

4.5 Real-world applications: Examples of MaaS

In the MaaS ecosystem, cab services are essential because they give customers flexible and on-demand transportation options. When combined with MaaS platforms, these services enhance the smooth and connected urban mobility experience by letting users plan, schedule, and pay for their trips all through a single online interface. As stated in a journal article by Giesecke, et al. (2016), both Uber and Lyft provide taxi services; from the end-user's perspective, the only distinctions between Uber, Lyft, and a taxi are the hailing procedure, tipping, and the (lower) cost per mile. But unlike the "classic" taxi business model, Uber and Lyft have simplified their operations by eliminating the

middleman. Instead, individual entrepreneurs bear the risks and expenses, with Uber and Lyft receiving only the funding necessary to facilitate the connection of customers and entrepreneurs. Sustainability is an issue for Uber and Lyft. Compared to taxis, their cars are frequently older, which makes them more of a contributor to local pollution. They also cause just as much traffic congestion. Unlike hired taxi drivers, who are "only" accountable for the operation of the journey, taxi entrepreneurs bear the entire risk and responsibility for all of their transportation assets (car, insurance, operating costs). Moreover, drivers for Uber and Lyft make less money per mile than owners of taxi businesses. As a result, the driver-entrepreneurs frequently find themselves in situations where their net pay is insufficient to support themselves, and they also lack retirement and health insurance. When car sharing first started, it was limited to fixed stations, from which the vehicle had to be picked up and dropped off. The 'free-floating' concept is instead used by Car2Go (affiliated with Daimler) and DriveNow (affiliated with BMW and Sixt). This allows cars to be picked up and dropped off at any legally permitted parking spot within a predefined area without having to worry about parking fees. From an end-user perspective, free-floating car sharing eliminates the middleman by combining the features of a taxi and a rental car. In terms of sustainability, car sharing is once more preferable to the production and use of privately owned vehicles. Additionally, Car2Go and DriveNow have an advantage over Uber and Lyft because they both use relatively new, compact vehicles. Both businesses currently use some EVs, which helps to reduce the environmental effect locally. Furthermore, since there are no paid drivers, car sharing does not entail dubious work environments from a socioeconomic perspective. Uber is researching AVs in an effort to eliminate the need for human service providers, precisely because of this problem. Even so, parking is a problem for car sharing, and this is probably the most detrimental aspect when it comes to sustainability. Being a true MaaS provider, Tuup combines several transportation options (taxi, car and bike sharing, parking, etc.) into a single, integrated mobile solution. But for the time being, Tuup is only concentrating on corporate customers. A flexible mobility benefit, a mobility management tool that integrates with the corporate travel management system, and an increase in employee satisfaction are all part of Tuup's value proposition for them. Employees can select sustainable and economical travel options with the help of Tuup's application, which makes it simple for end users to plan daily travel, compare prices for business and private travel, and make payments. Additionally, Tuup gathers high-quality mobility data from its users, enabling the optimization of mobility services and travel patterns to the advantage of urban travellers, their employers, and society at large. In Sweden (Gothenburg), UbiGo has adopted the role of "a broker of everyday travel," providing tailored transportation services to meet the needs and preferences of each individual traveller. They accomplish this by combining already-existing transportation options and service providers, such as taxis, public transportation, bike and car sharing, and rental cars, and then providing them to clients as a package through a single subscription service. The broker's business strategy is centered on acquiring mobility services as a business client from various transport service providers. The broker can theoretically negotiate lower prices for the individual trips by doing this on behalf of a large number of customers. However, Giesecke, et al. (2016) unequivocally demonstrates that the ecosystem requires the participation of users, transport service providers, and other stakeholders like ICT developers, research institutions, and society as a whole, represented by the city and the region. Though Moovel's integrated carsharing offer is only available through Car2Go, it is comparable to UbiGo. In that regard, Moovel is accessible in the same eight nations and cities as Car2Go. It is possible to view Moovel and Ubi Go as being inherently very sustainable in terms of their MaaS offerings. (Giesecke, et al., 2016)

As stated by Polydoropoulou, et al. (2020), considering a variety of MaaS schemes and pilots (such as Tuup, Whim, Ylläs Around, Kutsuplus, UbiGo, etc.) in the context of the research projects "MAASiFiE" and "Rural-MaaS," König et al. (2016), Aapaoja et al. (2017), and Eckhardt et al. (2017) came to a

conclusion on four categories of MaaS operator models: the MaaS operator as a private company, a PTP, a public-private partnership (PPP), and a public-private-people partnership (PPPP). According to their analysis, the PPP and PPPP models could significantly benefit users in rural areas, while the operator-based model for public transportation would be more common in cities, suburban areas, and interurban transportation, where public transportation is essential.

4.6 Business models within MaaS

MaaS is the umbrella term for both data monetization and vehicle subscription. In the quantitative aspect of our study, the author used surveys and interviews with experts in the field of mobility to learn about their perspectives. The goal is to learn more about our main stakeholders' areas of interest and how they view the potential and challenges that come with MaaS. With the help of this analysis, the author hopes to present the present state of the automotive and mobility sectors while also providing insightful information that will help to shape their future. MaaS offers a wide range of opportunities for stakeholders to investigate, with the common objective of promoting digital and sustainable BMs. This is because of its emphasis on digitalization and digital services. This investigation helps the readers visualize the mobility sector's future direction in addition to enhancing their comprehension of the dynamics of the industry as it exists today. Continuing the exploration, the thesis delves into the BMs encapsulated within the realm of MaaS, namely vehicle subscription and data monetization.

4.6.1 Driving change: Exploring the landscape of vehicle subscription services

Vehicle subscription models are becoming more and more popular among the three stakeholders considered in this research (OEMs, PTPs and SMCs), providing customers with a flexible alternative for traditional ownership. Thanks to this creative strategy, companies can now offer a wide variety of vehicles and services through subscription programs, meeting changing consumer demands for convenient, on-demand mobility. An article from Deloitte (2021) mentions that the value and appeal of owning a car has steadily declined in the last several years. Cars are no longer seen as status symbols, and this is not limited to younger generations. Many people are no longer willing to accept the long-term commitments and responsibilities that come with being a car owner. Conventional auto financing and leasing contracts are viewed negatively rather than positively by consumers in today's dynamic world, where people are always on the go and circumstances change quickly. According to Smania, et al. (2023), studies looking into consumers' opinions of these subscription services have been conducted. To the best of our knowledge, no study has examined how OEMs are implementing car subscription BMs or the long-term values that result from doing so. Given the emergence of car subscription services as a viable, expanding, and new form of transportation, there appears to be a research gap in this area.

The idea behind a subscription-based business model is straightforward: rather than making a single purchase, consumers pay a set amount regularly to gain access to the offer. From a company perspective, this ensures a regular and recurring revenue stream (MRR – monthly recurring revenue), customer retention, and an increased rate of interest over a long period over customer acquisition costs (Eichberger, 2021). According to Szamatowicz & Paundra (2019), people can reduce the expenses associated with owning products by only paying for the use of those items in the sharing economy. This calls into question the dominance of traditional ownership by luring businesses and customers to an access-based business model. Because the sharing economy is more sustainable than traditional ownership-based consumption, consumers are drawn to it as well. Subscription-based services, such as those for cars, involve customers paying regular fees to access goods and services. This model has seen a sharp rise in interest in recent years. According to Heineke, et al. (2023), the growth of the internet and the creation of new technologies are the main forces behind this transformation. Mobility

services like ride-hailing and car-sharing provide an alternative to owning a car, but they also have drawbacks, like being unavailable during busy hours and in some areas, being expensive for extended trips or rental periods, and not being able to leave personal belongings in the car, to mention a few. Put another way, ride-hailing and car-sharing are not a true replacement for owning a car, even though they provide an additional or alternative form of transportation to the public. Those of us who desire the benefits of owning a personal vehicle have not, up until now, discovered a true alternative.

Current researchers anticipate significant growth in the subscription market segment as a result of vehicle subscriptions, which have the potential to combine the best of both worlds. According to Deloitte (2021), this dynamic is being further accelerated by the global COVID-19 pandemic. An idea that was more subliminal before has gained traction due to the virus's scepticism about public and shared mobility: it is nearly impossible to replicate the level of comfort and hygiene people associate with their own vehicles. Although the global pandemic did not eliminate the need for private and corporate mobility, it did alter consumer preferences and raise the demand for flexible models such as vehicle subscriptions. In 2021, General Motors reported that its revenue from in-car subscription services exceeded $2 billion. By the end of the decade, the company anticipates growing this amount to $25 billion. In essence, that would place GM in the same category as Peloton, Spotify, and Netflix, thus showcasing the potential behind subscription models (Hawkins, 2022). Fig.19 also shows an estimate that, by 2025, subscription models will account for 8% of all new car registrations in the relevant customer segments (excluding OEM & Rent-a-Car segment). (Deloitte, 2021).

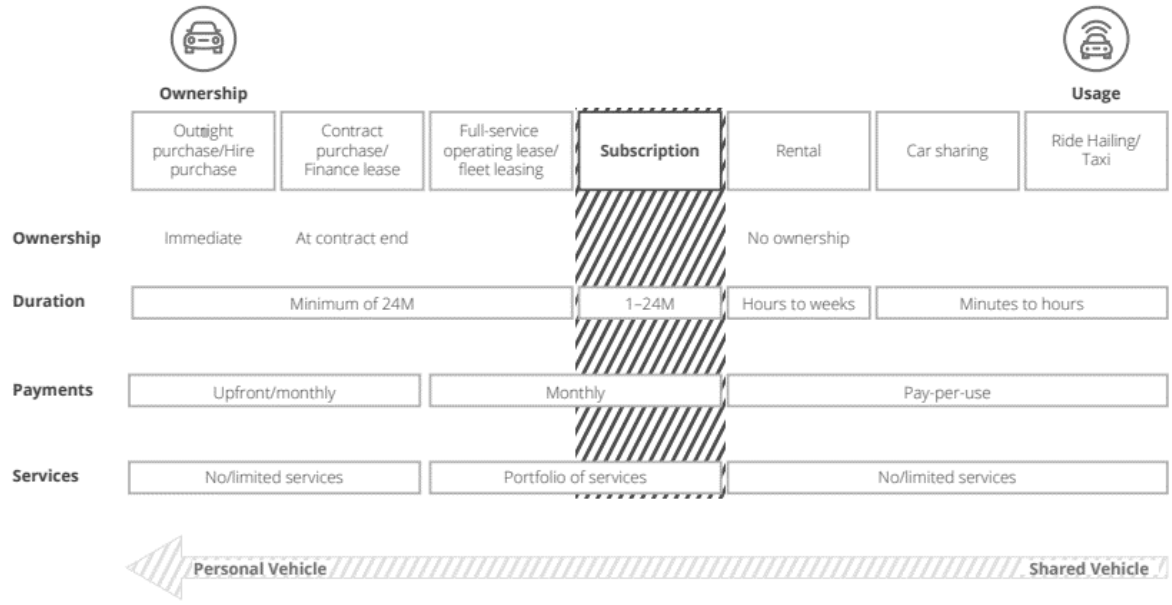


Fig. 19. Vehicle-based mobility product portfolio (Deloitte,2021)

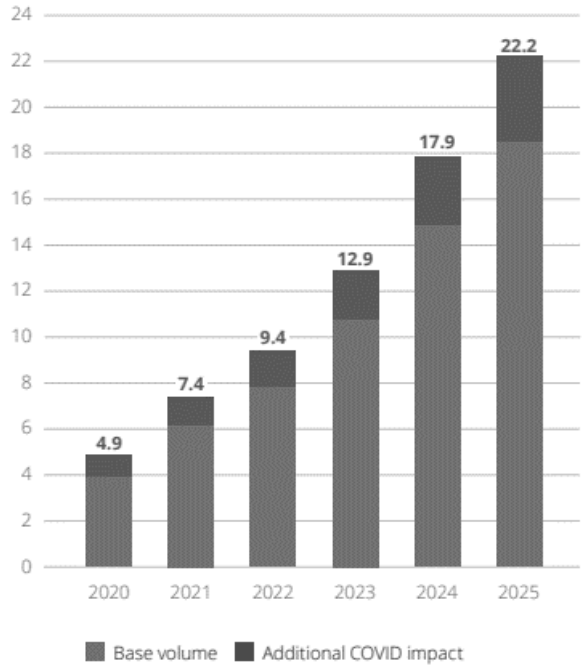


Fig. 20. Subscription share of new vehicle registrations in EU5 markets for private and corporate customers (in €bn) (Deloitte,2021)

Two conventional car characteristics that have been studied in the past (Szamatowicz & Paundra, 2019) and are known to affect intentions to use car services are: price and mileage limitations. Szamatowicz & Paundra (2019) also claim that it is well known that when it comes to making decisions, consumers prioritize price above all else. Researchers concur that the most significant consideration for consumers when deciding between a private vehicle and a shared car is financial benefits, which also rank among the top factors influencing their intentions to participate in the access-based economy. Klee and Mehling (2020) identify the following elements as contributing factors: an increase in the demand for luxurious products, a desire for "experiences," and a growing consciousness of sustainability. Additionally, ownership enables users to take control of the product without also taking on the associated risks. As burdens of ownership, they list the risk of product alteration and/or obsolescence, the risk of choosing the wrong product, the obligation to maintain the product, and the entire cost of products a customer does not always need. One must consider that high car service prices (such as those for subscription services) correlate with low intention to use alternative car services, and vice versa (de Luca & Di Pace, 2015). Szamatowicz & Paundra (2019) mention mileage limits as the second characteristic. In theory, mileage restrictions serve as a top on how much the car can be used, which is a major deterrent for many. This idea is similar to the range anxiety that drivers of electric cars may encounter. Drivers are not always consistent in their driving habits, and mileage restrictions (such as those pertaining to EVs) prevent them from using their cars for long-distance or unforeseen uses.

Pierce, et al. (2003) also talks about the psychological feeling of ownership, that a subscription vehicle might theoretically also result in psychological attachment. But it's reasonable to assume that a privately owned car will foster a far stronger sense of ownership for a variety of reasons. First of all, having a private vehicle typically requires a far larger commitment, which repeatedly fosters the growth of psychological ownership. Second, a car owner has far more control over the machine; they can easily alter its performance or appearance, for instance. Purchasing an item increases one's sense of control over it, which strengthens the attachment. Lastly, customers may find it challenging to locate a car that best suits their tastes because car subscription services typically offer a small assortment of

vehicles. According to Szamatowicz & Paundra (2019), in terms of access duration, in particular, the advent of car subscription services marks a significant evolution of the sharing economy model. Car subscription services give users monthly access to vehicles, in contrast to traditional carsharing or ridesharing services, which usually offer access by the minute or trip. With this longer-term access model, subscribers can enjoy the flexibility and convenience of car ownership without the financial strain and commitment that come with it. As with leasing, subscribers get all the advantages of car ownership plus the flexibility to swap or return their car at any time during their subscription. In addition, car subscription services enable a certain level of customization because every car is assigned to a single subscriber for the duration of their subscription. In spite of not being the legal owners of the vehicle, subscribers feel a sense of attachment and ownership because of this exclusivity. All things considered, it is expected that people will value a private car's attributes more highly than those of a subscription car because they will have a stronger emotional attachment to it (Szamatowicz & Paundra, 2019).

Eichberger (2021) also states that the vehicle software, or the car's operating system and its functionalities, is the central component of the business model for digital services in the automotive sector. The customer can enable additional features for their car through an app. Nowadays, almost all automakers have their own products. Mercedes Benz, for instance, is used in this article as an example of their “me connect” services. Through the related app, customers can directly reserve a variety of extra features for their connected car, such as remote parking assistance, smart control services, or vehicle setup.

While car subscriptions and rentals and leasing have certain similarities, they also differ in some ways. First, car subscription models provide drivers medium-term access to vehicles (typically from a few months to a few years) through the payment of a monthly fee that varies depending on the car model and the distance to be traveled. In contrast, rental models are based on short-term services (e.g., daily or weekly time). Second, consumers do not incur the cost of ownership—which comprises the significant upfront costs associated with acquisition and taxes—under subscription models, with the exception of fuel. In addition, unlike certain leasing agreements, the automaker is in charge of offering services like insurance, maintenance, overhauls, and replacement parts to ensure the desired car availability. (Smania, et al., 2023) (McKInsey&Company, 2016)

According to Stuchlik (2021), unlike traditional car ownership or leasing, subscription services typically do not require lengthy contract terms or sizable one-time payments, making them more accessible and affordable for many consumers. This flexibility allows subscribers to adapt their transportation needs to changing circumstances without being tied down by rigid contracts or financial commitments. Moreover, subscription decisions are often influenced by the depreciation associated with vehicle purchases, especially for new cars. By opting for a subscription model, customers can avoid the depreciation costs that come with vehicle ownership, as they are not responsible for the vehicle's long-term value. Instead, they can enjoy the benefits of using a car without worrying about its future resale value. Another key benefit of vehicle subscription is the ability to swap out cars on a regular basis, depending on the subscription package. This means that subscribers can access a variety of vehicles to suit their needs and preferences, whether it's driving a four-wheel drive in the winter or a convertible in the summer. The availability of a vehicle pool allows for customization and broadening of options, empowering users to tailor their transportation experience to their liking. Overall, the vehicle subscription model offers customers unparalleled flexibility, affordability, and convenience, making it an attractive alternative to traditional car ownership or leasing arrangements. By providing access to a diverse fleet of vehicles without the burdens of ownership, subscription services revolutionize the

way people think about transportation, offering a modern and adaptable solution to meet evolving mobility needs.

According to Skentzos (2023), the cost of constantly purchasing and selling cars to satisfy varying demand rises as your subscriber base grows. Financial inefficiencies result from having too few or too many cars because the inventory must closely match the number of active subscribers. If a fleet is too rapidly expanded without adequate demand forecasting, underutilization of those vehicles may result in losses. Utilizing data analytics and demand forecasting models to *optimize fleet size and mix* is a practical solution. You can determine the appropriate vehicle inventory levels by looking at past usage data and forecasting subscriber needs based on geography and demographics. One of the largest difficulties for a car subscription business as its subscriber base grows is *acquiring new customers at an affordable rate*. For businesses looking to grow their customer base steadily and at scale, paid advertising and promotions can get very costly. Over-reliance on sponsored marketing channels frequently results in unsustainable customer acquisition costs that reduce profit margins. To reduce costs per acquisition, businesses should instead concentrate more on loyalty incentives, referral programs, and organic channels. Subscription car services report that over half of their new members are referred by satisfied current members. Referral bonuses and loyalty programs encourage the growth of word-of-mouth. Although it takes longer, scaling through organic channels results in better unit economics and more sustainable growth. It becomes increasingly important to *stop revenue leakage as your subscriber base expands*. Earned money that is not collected because of things like failed payments or billing errors is referred to as revenue leakage. Inevitably, errors and unsuccessful automatic payments will occur when dealing with thousands of subscribers and dynamic billing needs. Revenue leakage in aftersales services has a major financial impact on the automotive industry. Recurring subscription services are subject to the same rules. Putting strong fraud prevention systems and automation into place is the answer.

Additionally, patterns and risks can be identified by advanced analytics to proactively stop revenue leakage. As your needs grow, machine learning systems will get better over time. If customer service is not provided effectively, there is a greater chance of negative experiences. With more customer touchpoints and intricate operations at scale, there are more chances for errors to occur if appropriate procedures aren't in place. Continually delivering a flawless experience will get harder and harder. *Prioritizing customer service* investments will help car subscription businesses grow without compromising customer satisfaction. As car subscription businesses grow, one of the biggest challenges is adhering to the many *regulations pertaining to lending, insurance, licensing, and consumer protection*. Following the law is essential but challenging for car subscriptions because they operate in an uncertain legal environment between leasing, short-term rentals, and traditional auto financing. Car subscription businesses must collaborate closely with legal and compliance specialists who are familiar with the various state laws in order to manage regulations. It is imperative to carry out thorough legal reviews prior to the introduction of any new product or campaign. Encouraging transparent communication with legislators and regulators can also assist in directing compliance initiatives in the proper way. The *back-end operations* of a car subscription business get increasingly complicated as they expand. To provide flawless client service, a fleet of thousands of vehicles requires sophisticated logistics and coordination, from managing vehicle inventory to cleaning and maintenance, deliveries and swaps, billing, and payments. It takes enormous operations teams and a great deal of coordination to manage the flow of vehicles into and out of the fleet, plan cleaning and maintenance, and carry out contactless deliveries on a large scale. Vehicle breakdowns, customer dissatisfaction, and fulfillment bottlenecks can all happen very quickly in the absence of appropriate procedures and systems. Optimizing intricate workflows through the use of operations software, such as field service management and fleet management systems, is the answer. To optimize efficiency as

you grow, you must adhere to lean principles and continuously improve your processes. Dashboards and operations metrics give visibility into issue areas. Car subscription businesses are able to maintain their high level of customer service even as they expand by effectively handling the operational challenges that arise behind the scenes.

When a car is purchased, the buyer pays a lump sum to the manufacturer or dealer in addition to the purchase price, but when a customer leases a vehicle, they are under contract with the provider for a number of years. MaaS services, like car rentals and sharing, release users from having to buy a specific vehicle, and the brief rental or sharing periods prevent significant financial flows to the provider. In contrast, clients who subscribe to car subscriptions must pay the dealer or manufacturer on a monthly basis and are committed to doing so for at least one month. It is advisable to use leasing offers as a guide for pricing. If automakers don't investigate the subscription business model, new competitors may pose a danger. First, since third-party platforms for the vehicle subscriptions would stand in between the customer and the manufacturer, manufacturers would no longer have direct contact with them. Furthermore, producers might just start providing automobiles, much like other MaaS services like ridesharing. As a result, they need to diversify into fleet management, customer-specific offers, and value-based pricing. Conversely, dealerships could collaborate with tech start-ups to offer comparable offers to the market. For suppliers, effective fleet management might become especially crucial. It is better to offer younger used cars instead of brand-new ones on a subscription basis because of depreciation. A vehicle may eventually be integrated into other MaaS services like car sharing if it is too old for auto subscriptions. Additionally, adopting a subscription business model enables organizations to maintain flexibility and adjust to new developments like shared mobility solutions and MaaS. Businesses can establish themselves as leaders in the changing mobility landscape by collaborating with tech companies or incorporating subscription services into larger MaaS ecosystems. Moreover, fleet management becomes even more important for businesses that provide car subscription services. Through efficient management of the lifecycle and utilization of their fleet vehicles, businesses can reduce depreciation expenses and increase profitability. This could entail providing subscription-based ownership of younger used cars rather than brand-new ones in order to reduce depreciation risks and guarantee a viable business model.

Because of its built-in adaptability and compatibility with millennial tastes, car subscription services have become quite popular, especially in Europe. This innovative model provides millennials with a flexible and convenient substitute for traditional car ownership, meeting their changing mobility needs and dynamic lifestyle. Among the notable European subscription services are Carvolution in Switzerland, Onto in the UK, Drover in the UK, Wagonex in the UK, Finn in Germany, and Bipi in Spain (Tracxn, 2024). All of the major OEMs, including Hyundai, Nissan, and Volkswagen, as well as the luxury OEM brands, including Mercedes, Cadillac, Volvo, Porsche etc., have dabbled in the vehicle subscription market. "Care by Volvo," "Abo-a-Car" from Volkswagen Financial Services, "CONQAR" from SEAT, and "KINTO FLEX" from Toyota are a few examples. Volkswagen offers a minimum subscription period of three months, while Volvo offers a 30-day trial period. Cadillac vehicles can be obtained in 48 hours, whereas SEAT requires a 12-week lead time. Mercedes-Benz customers have the option to switch out their cars twelve times a year. All of the offers have the same general idea, but their specifics vary (Stuchlik, 2021). Thus, it is evident that this new car usage model is not limited to a specific group of car manufacturers. And for these brands, the outcome has been encouraging. According to Porsche, eighty percent of all users of its car subscription plan – Porsche Drive, are brand new. Within a year of its launch, Volvo's car subscription service in the UK accounted for 15% of total retail sales. Vehicle subscription services provide OEMs with a new source of income as well as a way to establish and fortify relationships with prospective customer base (Ulity Team, 2022). Through these services, users can access a wide fleet of cars on a subscription basis, enjoying a hassle-free experience

that frequently includes maintenance, insurance, and the freedom to swap cars to suit changing tastes (Tracxn, 2024). According to EU-Startups (2024), car-subscription startups have made significant progress throughout Europe in the last three years, with rapid advancements. Driven by its transition to an entirely electric fleet, Munich-based FINN raised €100 million in Series C funding. With a €115 million pool to improve digital car subscriptions in Spain, Madrid-based REVEL also made progress. UK-based Onto used a €113 million credit facility to accelerate the transition to EVs. The Italian auto retailer Brumbrum and the car subscription marketplace Swipcar, located in Barcelona, were acquired by London-based Cazoo, which increased its footprint throughout Europe. Cazoo also signalled further growth with the acquisition of Drover, a well-known car subscription service. €10.4 million was given to Swiss startup Carvolution to expand its automobile subscription business, while Munich-based Cluno received €25 million in Series B funding. According to (Singh, 2018), there were eight platform/software providers in the vehicle subscription market in North America and Europe in 2017–2018, including Canvas, Flexidrive, and Carma; twelve startup-led technology programs (YoYo, DriveFlow, and Revolve); eight dealer-led programs (Drive Germain, Park Place Select, and Lux Car); seven mobility provider-led programs (ZipCar Commuter, Maven Reserve, and Lyft All Access); two mainstream car manufacturer-led programs (Ford Canvas and Hyundai's Ioniq Unlimited); and one super luxury car manufacturer-led program (Porsche's Passport). A depiction of how these programmes look is also shown by Singh (2018). Fig. 21 shows major vehicle subscription programs in Europe and North America, categorizing them from 'super-luxury' to 'tech-startups' (Singh, 2018).

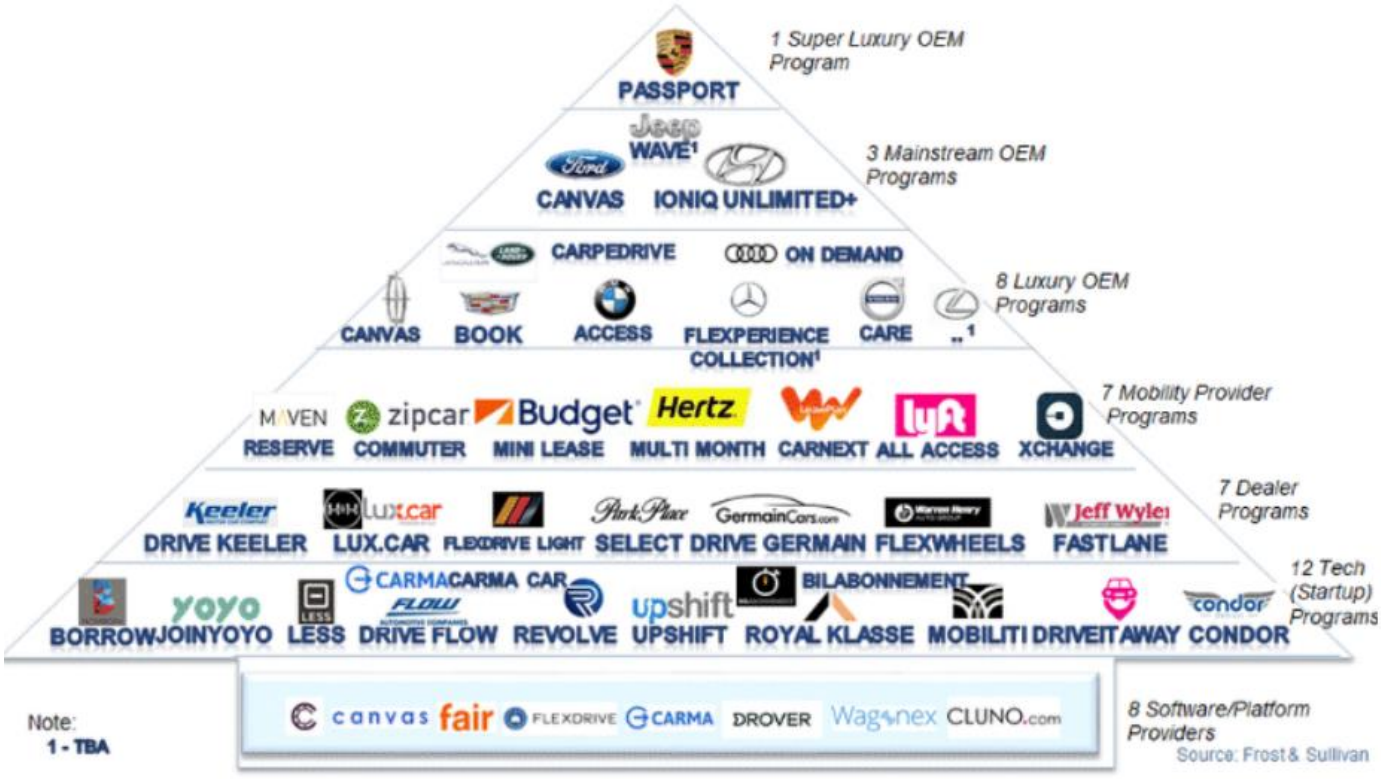


Fig. 21. Major Vehicle Subscription Programmes in Europe and North America (Singh, 2018)

The landscape of vehicle-subscription services in Europe is one of the main research questions, and it looks at it from the perspectives of OEMs, PTPs, and SMCs. These stakeholders are the focus of the study's quantitative section, which aims to gather crucial information about a range of subscription service aspects. This includes a thorough examination of subscription offerings, including the combination of features and services, as well as a discussion of industry opportunities, issues, and

collaborative approaches. The author carried out a thorough analysis to comprehend the various viewpoints and strategies taken by various companies and stakeholders toward subscription-based BMs by interacting with industry professionals who are actively involved in the market. Moving on, the authors aim to understand another topic of this research – data monetization.

4.6.2 Unlocking value: Strategies and opportunities for vehicle data monetization

Vehicles in the connected automotive world of today produce enormous volumes of data that are extremely valuable to a variety of stakeholders. The process of obtaining, evaluating, and using this data to open up new business opportunities and generate income streams for the entire automotive ecosystem is known as vehicle data monetization. Vehicle data monetization has a wide range of potential applications, from insurance risk assessment and urban planning to predictive maintenance and personalized services. These applications could bring about unprecedented insights and innovation in the transportation sector. Fig. 22 shows the three data monetization choices, according to Wixom, (2014).

	Selling	Bartering	Wrapping
Example:	▪ A retailer exchanges POS data to a data aggregator for money ▪ A data aggregator exchanges market basket reporting and analytics to a retailer for money	▪ A retailer provides POS data to a supplier in exchange for a software tool that helps the retailer analyze and improve selling the vendor's products	▪ A supplier provides product reporting to a retailer at no charge, and over time receives increased sales by that vendor
What do you get in exchange for your data?	Money	Products or services	Increased revenues from core products and services
Who should govern?	Dedicated organizational structure or business unit	Shared services group	Product management
What are key challenges?	▪ Complying with legal, regulatory, and contractual constraints ▪ Setting the right price ▪ Leveraging advanced technology and data science ▪ Sustaining competitive advantage	▪ Identifying and coordinating bartering across the enterprise ▪ Complying with legal, regulatory, and contractual constraints ▪ Preserving value during the bartering exchange process	▪ Avoiding merely "raising the bar" of core offerings ▪ Meeting promised or expected service levels to avoid damage to important stakeholder relationships

Fig. 22 Three data monetization choices (Wixom, 2014)

Talking about the strategies involved in data monetization, three primary strategies are used by businesses to manage their digital data: selling, bartering, and wrapping. These three approaches vary according to the type of company being tested, including its size, capabilities, business plans, and sector (Miro, 2021). Wixom (2014) defines data monetization as "the act of exchanging information-based products and services for legal tender or something of perceived equivalent value". Wixom also says that for years, businesses have been selling data. Think about the retail sector. For many years, merchants have supplied point-of-sale (POS) transaction data to consumer research companies. These companies then resold aggregated data along with related reporting and analytics to retailers and other entities seeking to gain a deeper understanding of product sales. Retailers stand to gain significantly from the sale of point-of-sale (POS) data, which is a valuable source of raw material for aggregators. It is more difficult to sell other types of retail data, though. For instance, a lot fewer retailers sell customer data from their loyalty programs because the lure of additional revenue is

outweighed by privacy concerns and contractual obligations. In previous decades, the majority of businesses used data to create internal business value by examining customer needs and operational procedures, then finding areas for innovation and improvement. With the monetization of data, more businesses are seeking to sell, trade, or otherwise create value from data for external parties. This raises the bar for data. Therefore, regardless of the data monetization strategy you choose, even though it may appear like a hot choice to drive top-line growth, it actually necessitates careful thought and due diligence. Companies have to make sure they have allocated the appropriate resources if they want to profit from data monetization.

McKinsey (2016) identified and evaluated the requirements of potential car data-enabled use cases, as well as consumer perspectives on the possibility of obtaining access to car-generated data, through an extensive research program that included surveys, interviews, and observations. McKinsey (2016) also estimated that, by 2030, the global revenue stream from the monetization of automobile data could reach USD 450–750 billion. The potential for industry participants depends on their capacity to swiftly develop and test car data-driven products and services that are centered on compelling customer propositions; and create new BMs based on cutting-edge capabilities, partnerships, and technological innovation that push the boundaries of the automotive industry today. All of the CASE trends that have been mentioned earlier have contributed—both now and in the future—to an unparalleled surge in digital data generated by cars, which has important ramifications for both new and established players in the automotive industry. Enterprises from high-tech, insurance, telecommunications, and other seemingly "automotive adjacent" sectors will be pivotal in facilitating car data-related services that consumers might be prepared to pay for. Car data will become a major topic on the automotive industry agenda and, if its potential is fully realized, highly monetizable as new features and services proliferate. As per Hood, et al. (n.d.), where to fit into the connected car value chain is one of the first choices businesses making money off of vehicle data have to make. And there are positions that businesses could play:

- *Developers*, creating end-user products that utilize data.
- *Providers*, marketing the service offerings to B2C and B2B audiences.
- *Generators*, creating end products capable of capturing data.
- *Transmitters*, securely delivering the data to a central repository.
- *Manipulators*, aggregating data from various sources into a usable format.

Hood, et al. (n.d.) states that OEMs may reap significant advantages by being aware of the components of a car and when they are most likely to fail. Predictive analytics enables businesses to anticipate potential warranty and recall issues, while real-time data from vehicle sensors can detect issues early on. Additionally, OEMs and dealers can benefit from this type of data by using it to optimize technician resource plans and parts inventories. Furthermore, in order to increase brand affinity and loyalty, OEMs can create better, more tailored customer experiences by having a deeper understanding of how consumers use their cars. OEMs and other industry participants are investigating a broad range of data-based products and services, such as user-based insurance, mobile commerce, mobility-as-a-service (MaaS), infotainment, behavioural and geo-based advertising, and personal health monitoring, in terms of external revenue opportunities. But a lot of OEMs are already demonstrating how vulnerable they are to both current and potential competitors who are trying to find ways around them. When it comes to user-based insurance, for example, insurance companies can obtain vehicle usage data by simply plugging in a device, negating the need to communicate with OEMs.

Manufacturers of automobiles may also encounter difficulties due to strong consumer opposition to the gathering of biometric data (Hood, et al., n.d.).

According to Simoudis (2017), for fleet-based on-demand personal mobility or shared mobility, the value chain consists of four components:

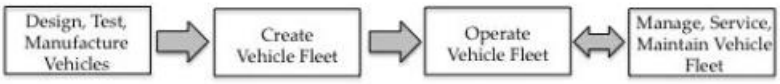


Fig. 23 The value chain for fleet-based on-demand shared mobility *(Simoudis, 2017)*

While the importance of data and artificial intelligence in enabling autonomous driving is starting to be recognized, their significance in each and every facet of fleet-based on-demand mobility services is less well understood. Big data and AI enhance every link in this value chain by enabling insights-based decision-making, task automation, and the development of novel BMs for the transportation industry. Some of these models will require extensive data sharing among the participants in the new value chain, who must be driven by value exchange. Mitsubishi Motors recently unveiled an example of value exchange. For its vehicle owners, Mitsubishi has created a mobile application to gather driving data. The OEM will reward participating drivers with gift cards and oil changes in exchange for their access to the driving data that the application collects. It then offers the gathered data to auto insurance companies, making money off of it. (Simoudis, 2017)

Simoudis (2017) also states that by utilizing big data and artificial intelligence, firms that order vehicles from OEMs and then lease them to businesses running on-demand shared mobility fleets can realize significant value. Specifically, by examining:

- The information that fleet operators provide regarding the performance of individual vehicles in particular fleets as well as the different circumstances (weather, road conditions, etc.).
- Vehicle manufacturers and fleet operators supplying vehicle configuration data for each vehicle in these fleets.
- Previous financial and insurance information relevant to the fleet acquisition (which they probably have),

they can find information that gives them the ability to bargain with manufacturers for cheaper car prices per unit and with insurers for cheaper insurance rates on a regional and fleet operator basis. Additionally, once a fleet operator's lease on a vehicle expires, they will know how to keep taking advantage of the fleet's vehicles financially. They will have a favourable effect on their total fleet investments in this way.

As stated by Simoudis (2017), the current understanding of brand loyalty will shift as the automotive market moves from the car ownership-centric model to the hybrid model, which combines car ownership with on-demand transportation services. The number of miles driven in an OEM's car while using a fleet operator's service will be used to determine loyalty rather than the buyer's propensity to keep buying from a specific OEM. The new model will compete for each customer's loyalty by pitting the OEM against the fleet operator. The OEM and fleet operators will always have a challenge in determining the share of revenue-miles travelled by customers at any given time, which will translate into share of wallet (Simoudis, 2017). As per Martinez (2022), the long-term approach should be to promote brand loyalty since it will guarantee a source of income. Let your short-term money-making ideas be a bonus if you have any.

Simoudis (2017) suggests that big data and artificial intelligence will be extremely valuable in understanding loyalty, improving the customer experience in every interaction, and increasing revenue-miles travelled by each customer in addition to optimizing service convenience. The customer's experience doesn't end with the car. Multimodal, end-to-end, personalized ground transportation solutions can be developed through data-driven artificial intelligence. Simoudis (2017) also suggests that fleets providing ride-hailing and ridesharing services via AVs (including passenger shuttles) will produce a lot of big data, some examples of which are as follows:

- Demand-driven costs for every journey,
- Information about the passenger(s) on each journey, such as whether they were carrying luggage, as well as details about their profiles,
- Travel and waiting periods for passengers,
- Vehicle idle miles vs revenue-generating miles,
- Sensor data from the vehicle and the cabin, such as the state of the cabin at the time of each trip and health information from each passenger (such as body temperature, heart rate, perspiration, and alertness),
- Information gathered while the car is moving from other infrastructures and the transportation system,
- Conditions of the weather and traffic on each route travelled.

As stated in a blog by Goldberg (2023), the integration of cutting-edge technologies such as software-defined vehicles (SDVs) and Over-the-Air (OTA) connectivity presents opportunities and challenges as the automotive industry continues to evolve, especially in the areas of cybersecurity and data protection. Massive data collection and analysis has the potential to improve vehicle performance, safety, and user experience, but it also raises questions about driver and vehicle owner privacy and security. The financial ramifications of insufficient data protection measures are substantial, as the average cost of a single data breach is projected to be $4.5 million in 2023. But the consequences go beyond financial losses; they also include harm to a brand's reputation and a decline in customer confidence. No OEM wants to be linked to a security breach that jeopardizes drivers' privacy or makes it possible for hackers to follow them around and obtain personal information.

Furthermore, OTA connectivity creates a new attack surface that could be exploited by cybercriminals. Threats to data security and passenger safety could arise from hackers using flaws in the software or network infrastructure to obtain unauthorized access to car systems. In SDVs, where software is essential to defining the behaviour and functionality of the vehicle, this risk is increased. The potential for an attack to start in a low-safety domain or application and spread to high-safety systems emphasizes the necessity of strong cybersecurity protections in place at every stage of the vehicle architecture. OEMs and other industry participants need to prioritize taking proactive steps to improve cybersecurity and protect data privacy in response to these challenges. To reduce the possibility of unauthorized access and data breaches, this entails putting encryption protocols, access controls, and intrusion detection systems into place. Furthermore, in an increasingly digitalized and networked ecosystem, maintaining the integrity and reliability of automotive systems and staying ahead of evolving cyber threats require constant monitoring, sharing of threat intelligence, and cooperation with cybersecurity experts.

Businesses of all sizes, from small startups to massive tech companies, are increasingly using data monetization strategies to get value out of their massive data sets. Organizations can improve customer experiences, find new revenue streams, and obtain a competitive edge in the market by

leveraging and analysing data. A blog from Kelly (n.d.) mentions actual business cases that use different data monetization strategies to spur innovation and expansion.

- INRIX provides mobility and traffic analytics solutions and is a prime example of successful automotive data monetization. Through the use of real-time data from various sources, including mobile apps, GPS devices, and connected cars, they provide information about travel times, traffic flow, and congestion. Through subscription-based services designed for companies, governments, and transportation agencies, INRIX makes money off of this data. With the help of these solutions, clients can improve overall traffic management, ease congestion, and plan routes more efficiently.
- Peugeot and Continental AG welcome the monetization of vehicle data with their "Connected Services" and “Continental Automotive Cloud” package respectively. They collect data on usage patterns, driving behaviour, and performance thanks to IoT sensors and connectivity features. Value-added services like predictive maintenance alerts, remote diagnostics, and customized driving advice are powered by this data. Subscription models and upselling of extra features that improve the driving experience are how monetization happens.
- With the help of its "IBM Watson IoT" platform, IBM is a master at monetizing automotive data. IBM enables automotive companies to improve vehicle performance, driver safety, and operational efficiency through the integration of sensors, IoT devices, and analytics. Through specialized IoT solutions, advisory services, and cloud-based analytics platforms for producers, suppliers, and industry participants, they make money off of automotive data.
- Using vehicle telemetry data and over-the-air software updates, Tesla exemplifies successful automotive data monetization. Tesla automobiles gather information on driver behaviour, battery health, and performance thanks to their sophisticated sensors and networking. Subscription-based access to premium features like infotainment services and Autopilot updates is made possible by this data. Data is also used by Tesla to improve its products, create new features, and guide future design decisions.
- Caruso GmbH is a data marketplace that helps industry participants exchange automotive data. Caruso, which connects suppliers, manufacturers, repair shops, insurers, and fleet operators, makes money from licensing contracts and transaction fees. Partners can unlock the value of their data assets by gaining access to a range of automotive data, such as maintenance records, parts catalogues, and diagnostics.

There are many obstacles and unknowns for OEMs, PTPs, and SMCs to navigate as the connected vehicle market develops. Choosing a competitive advantage and market positioning strategy has become more challenging due to the landscape's rapid evolution and complexity. Some of the important issues and questions these entities face is discussed by Hood, et al. (n.d.):

- **Who has access to and ownership of the data?** The data sets that are shared among OEMs, service providers, and customers in interconnected ecosystems are frequently the most fascinating. Nonetheless, data from many recent studies indicate that customers may not feel entirely at ease with a particular kind of business handling their connected data.
- **Are connected data services willing to be paid for by consumers?** How can you get customers to pay when they are used to free apps and basic services? We anticipate that the entire range of services will comprise both complimentary and compensated offerings.
- **Who and how should we collaborate with?** Numerous OEMs have been attempting for years to construct the complete mobility data ecosystem inside their own walls. On the other hand, a lot of them are now trying to implement open platform tactics created in collaboration with external partners like technology firms, software companies, shared mobility, and fleet-related companies.

- **How can the customer and vehicle data be protected?** Customers might be more open to exchanging information for services and attributes that are thought to be advantageous. Technology companies have been exploiting this for a while, so OEMs and other mobility companies might have a lot to learn from them. But any business will probably lose clients' confidence fast if the information they share is jeopardized.

Engaging OEMs, PTPs, and SMCs to get their thoughts on data monetization as a new business model in the automotive sector is the quantitative portion of the thesis. This was done through surveys and interviews conducted with these different stakeholders. In order to do this, in-depth analyses were carried out in order to determine how each stakeholder group views and negotiates the data monetization landscape while considering their unique priorities, concerns, and points of view. The study explores a number of topics, such as issues with data privacy, ensuring regulatory compliance, preferred methods of monetization, and general worries about data security and moral ramifications. The study intends to offer important insights into the various viewpoints and approaches used by various stakeholders in utilizing data as a valuable asset in the automotive ecosystem by examining these dimensions. The next section gives a detailed description of the research methodology used in this thesis. Apart from investigating existing literature, this thesis aims to examine the industry perspective on the topics discussed earlier.

5. Detailed Methodology

The research approach adopted for this study is structured to combine both qualitative and quantitative analyses, utilizing a comprehensive approach for examining the complicated environment of the automotive industry's revolutionary path. The qualitative analysis section includes a methodical review of the literature that offers a thorough investigation of modern technologies, approaches, and distinct characteristics present in the automotive industry. These chapters form a fundamental basis for the study, which provides insights into the evolution of the industry, technological advancements, and prevalent trends. Complementing the qualitative strand, the quantitative component of the research involves gathering and assessing stakeholder opinions to answer the research questions mentioned above. With a focus on three major stakeholder groups—OEMs, PTPs, and SMCs—this study seeks to gather and compile the various viewpoints and insights of professionals in the field. By interacting with these stakeholders, one can directly explore their perspectives, ideas, and outlooks about AVs and shared mobility solutions, the future of mobility, and the industry's adoption techniques towards upcoming BMs.
A more thorough explanation of the steps in a research process can be found in the Saunders research onion layers (Saunders, et al., 2019). It offers a practical step-by-step process for designing a research methodology. The stages of the Saunders research onion consist of:

- Research Philosophy
- Research Approach
- Research Strategies
- Research Choice
- Research time horizon

The research strategy outlines the researcher's intended method of operation (Indeed Editorial Team, 2022). In order to obtain a comprehensive understanding of automated and shared mobility, MaaS, and emerging BMs in the automotive industry, this research takes a comprehensive approach by integrating survey/questionnaire methodology and interview methodology. Combining these two approaches allows us to dive deeply into minute details and contextual nuances through in-depth

interviews, while also casting a wide net to capture a variety of perspectives from a larger sample through surveys.

- Questionnaires or surveys: Surveys and questionnaires can help researchers gather data that will be easy to analyse quickly. Usually, they consist of a brief series of inquiries along with a variety of answers. Since most survey data is not numerically recorded, questionnaires and surveys are a type of research methodology most frequently used to produce qualitative results. Research using surveys or questionnaires can yield quantitative results in certain situations because the responses can be converted into statistics. Saunders, et al. (2019) states that surveys/questionnaires are among the best and most affordable research strategies. With this approach, rich and trustworthy data can be gathered. Surveys typically involve sampling a representative subset of the population and are employed in both qualitative and quantitative research projects. According to Glasow (2005), although they cannot be specifically controlled by the researcher, independent and dependent variables are used in survey research to define the study's scope. The researcher needs to predicate a model that identifies the expected relationships among these variables before administering the survey. Next, a survey is created to compare this model with the phenomenon's observations.
- Interviews: An interview is a kind of research method that focuses on extracting bits and pieces of qualitative data, much like a case study. This can be done by researchers over the phone or through video conference. During an interview, a researcher will ask a participant a series of questions and then let them elaborate on the study. Then, not only can the researcher confirm quantitative data sets, but they can also document the emotional responses that are made. The researcher can then take the qualitative responses and convert them into statistics, just like in a survey or questionnaire (Indeed Editorial Team, 2022). The methodology of interview research involves conducting structured or semi-structured conversations with individuals or groups to obtain detailed insights, viewpoints, and experiences. Researchers can delve into intricate topics, unearth rich narratives, and record nuanced understandings through interviews that might not be possible with other techniques. Interviews can be classified into three categories: semi-structured, where questions are open-ended to allow for flexibility and exploration, unstructured, where there are no predetermined questions, and the interview can be conducted more naturally and conversationally (University Writing Center, 2014).

The author reached a larger audience and collected quantitative data on a variety of subjects related to the broad topics of autonomous and shared mobility. This is made possible by the survey/questionnaire methodology. The author can systematically gather responses from a large sample using structured questionnaires, which allows us to quantify trends, patterns, and preferences among various stakeholder groups. This methodology is ideal for investigating wide research questions and findings that can be applied generally because it provides scalability, efficiency, and statistical rigor (Jones, et al., 2013). On the other hand, the author can dig deeper into particular issues with the interview methodology, revealing rich narratives, insights, and experiences that might not be captured by surveys alone. The author can have meaningful conversations with key stakeholders (OEMs, PTPs, SMCs, in this case) about automated and shared mobility, MaaS, and emerging BMs by using semi-structured interviews to learn about their perspectives, motivations, and challenges. This qualitative approach enables adaptability, flexibility, and depth of investigation, thereby promoting a deeper comprehension of intricate phenomena and revealing subtleties that might lead to a

constructive quantitative design, thereby yielding statistical data, numerical findings, and visual representations that enhance comprehension of the research topics and questions at hand. Through the utilization of survey/questionnaire and interview methodologies, the author is able to validate results, triangulate findings, and offer a thorough analysis of the research topic. The author can close the gap between breadth and depth with this integrated approach, which provides an in-depth assessment of the opportunities, challenges, and dynamics influencing our research topics.

A depiction of the methodology process (Fig. 24) will help to understand how the research was carried out. The research developed through four meticulous phases. Initially, a comprehensive literature review was carried out to grasp the current scenario, available resources, and ongoing research projects within the targeted field. Subsequently, the emphasis shifted to the crucial stage of data collection, where a unique survey/questionnaire was created to address identified gaps. The questionnaires were carefully structured to ensure simplicity and clarity to aid in understanding. Separate sets of questions were designed to cater to different stakeholders - OEMs, PTPs, and SMCs. Utilizing various channels such as emails, phone calls, LinkedIn, and Xing, over 120 industry professionals involved in the automotive industry and particularly CASE mobility were approached. The process involved diligent follow-ups to optimize participation rates. The data analysis phase followed after receiving responses from over 23 different companies. In-depth exploration of stakeholder perspectives, ideas, and viewpoints on fundamental subjects such as autonomous and shared mobility, MaaS, vehicle subscription models, and data monetization was the main goal here. Determining how stakeholder perspectives vary over time and among various organizational roles was emphasized. A primary goal was also to determine which stakeholders showed a greater interest in discovering more about these topics because of the potential advantages for revenue generation, technological advancements, and brand growth. Ultimately, in the thesis's final section, graphical and tabular techniques were used to present results and findings of our surveys and interviews.

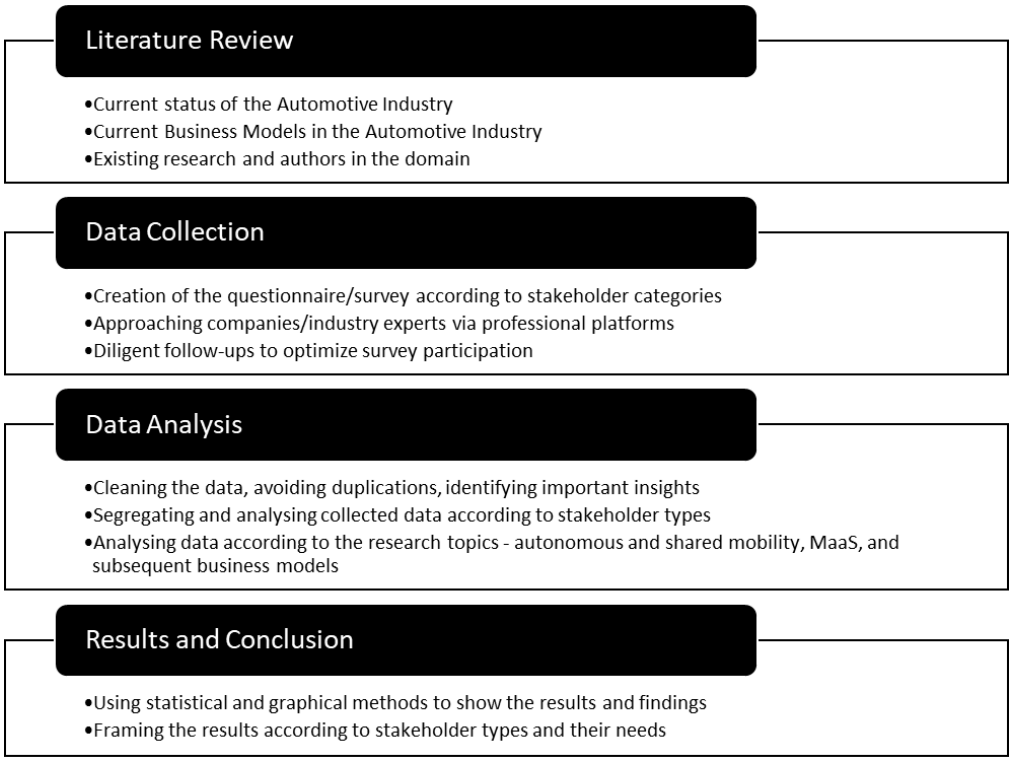


Fig. 24 Methodology and Process

In the last stage, the author applied a method of interviewing to go more deeply into particular topics that needed in-depth analysis. The author managed to approach seven industry experts from their professional and academic network to conduct short and structured interviews to gain further insights on the survey findings. Acknowledging the hectic schedules of professionals in the field, the author conducted two interview sessions. The vehicle subscription and data monetization BMs were the main topics of these interviews, which allowed for a detailed examination of the minute details surrounding these subjects. The next sections will dig deeper into the processes used in survey and interview methodologies.

5.1 Surveying stakeholder perceptions: Understanding industry perspectives

Referring to Aryal (2023), in order to ensure that a survey or questionnaire is relevant, clear, and appealing to respondents, it is important to carefully consider a number of factors when designing one. The questionnaire should look for information that is difficult to find in other sources and address a noteworthy subject that stimulates respondents' interest. It should be succinct but thorough, refraining from using double negatives and condensing several questions into one. It is imperative to provide respondents with comprehensive and unambiguous instructions to facilitate their journey through the survey. Additionally, the questions ought to be arranged logically, progressing from broad to more specialized queries. The design should also try to gather data that can be used for further analysis, providing insightful information to support the goals of the study. Following these guidelines will help the questionnaire or survey collect relevant data efficiently while increasing cooperation and engagement from respondents. The decision between restricted and unrestricted questions in survey and questionnaire design depends on the goals of the study and the kind of information that is being sought. Closed-ended or restricted questions present respondents with predefined options like checkboxes, multiple-choice questions, or yes/no choices. Although it is easy to tabulate and compile the answers to these questions, the depth of respondent insights may be limited. Conversely, open-ended, or unrestricted questions enable respondents to freely express their thoughts and feelings, yielding rich qualitative data. Even though gathering information from open-ended questions could be more difficult, they provide insightful information about the range of emotions that respondents experience. Thus, the research objectives should serve as a guide when choosing between restricted and unrestricted questions. Restricted questions are better if the goal is to collect quantitative data from every respondent because they are easier to quantify. To ensure thorough data collection, it is advised to develop a scale to quantify sentiments or emotions if the goal is to examine the subtleties of these feelings.

According to Aryal (2023), a range of formats are used in survey and questionnaire design to accommodate various research goals and requirements for data collection:

- Structured Questionnaires: These are perfect for quantitative research because they offer standardized data that is simple to analyse. They have predefined, fixed questions with specific response options.
- Unstructured Questionnaires: Respondents can freely express their ideas in response to open-ended questions, which produce rich qualitative insights. Feedback forms that include spaces for suggestions and comments are one example.
- Semi-structured questionnaires: These offer both quantitative and qualitative data by combining open-ended and closed-ended questions in a format that strikes a balance between structured and unstructured formats. Example: Multiple-choice questionnaires with comment sections and employee feedback.

- Dichotomous Questionnaires: These provide simple data for analysis because they have only two possible answers, usually "yes" or "no." For instance, health assessment forms that inquire about the presence or absence of a symptom.
- Multiple-choice questions allow respondents to select the most pertinent response by letting them choose from pre-defined options that are adaptable to a variety of topics. Example: Market research surveys that ask participants to select their favourite features of a product.
- Likert scale questionnaires are used to gauge attitudes and opinions. Respondents provide nuanced insights by rating how much they agree or disagree on a scale. An illustration would be employee engagement surveys, which range in satisfaction from "strongly agree" to "strongly disagree."

To guarantee its efficacy, the survey created for this study underwent extensive planning and multiple revisions. It is divided into five main sections, each of which stands for a significant idea in the overall structure. The survey starts off with company information like size, number of employees, products etc. and then moves towards exploring the broad topic of "autonomous and shared driving," it then gradually moves into more specialized areas, such as MaaS, and then more focused ideas, like "vehicle subscription" and "data monetization." Respondents are able to become acquainted with the broad themes of the survey and gradually delve deeper into more specialized subjects, thereby following a logical progression of questions, thanks to this methodical approach. This method not only makes the respondent experience more seamless, but it also guarantees that respondents are well-equipped to offer meaningful feedback on every topic addressed in the survey.

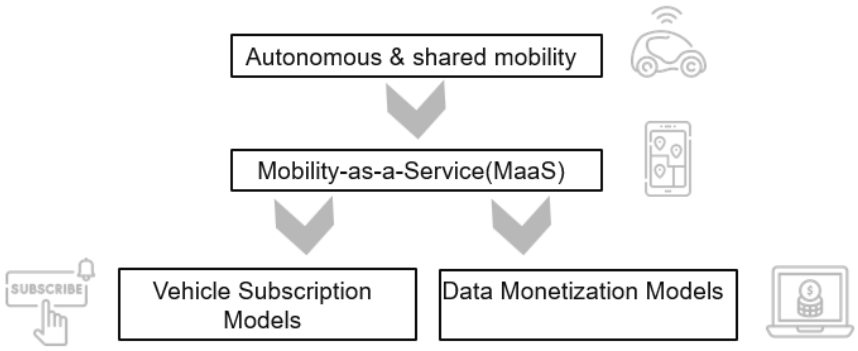


Fig. 25. Conceptual flow of the thesis

Understanding the distinct qualities and preferences of diverse stakeholders is essential to customizing our approach to interact with them. A strategic approach was used to create our questionnaire, taking into consideration variables like company reach, size, fleet capacity, revenue streams, and market positioning (whether in the luxury or regular market segments), in recognition of the diverse landscape of businesses within the automotive and mobility industry. Through adherence to these guidelines, the aim was to formulate inquiries that are in line with the distinct preferences and concerns of every stakeholder group. The survey helped us obtain insights that are representative of the industry's varied priorities and viewpoints, in addition to being pertinent and significant, thanks to this customized approach.

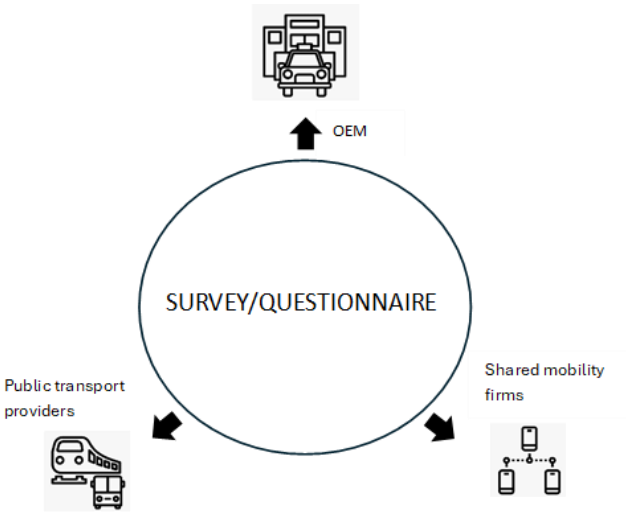


Fig. 26. Survey approach to the three different stakeholders

5.1.1 For automotive industry OEMs

Specifically designed to interact with automotive OEMs, the questionnaire is divided into discrete sections in order to thoroughly examine their viewpoints and approaches concerning major market developments. A number of advantages set established automotive OEMs apart from shared mobility providers, automotive technology companies, and smaller players in the market: Brand recognition and reputation, manufacturing infrastructure, R&D and innovation, financial stability, brand loyalty, customer relationships, vertical integration, etc. The author reached out to 33 automotive OEMs with establishments and operations in Europe. In order to guarantee the highest level of involvement, the author got in touch with 74 people from these OEMs. The author was able to get responses from 10 of the top European OEMs by outlining the goals of the study and its possible contributions. A wide range of topics was covered in our main section on AVs, including customer acceptance, pricing considerations, ease of use, obstacles faced during adoption, possible accelerators, and safety concerns. In the structured part of our questionnaire, the survey incorporates targeted inquiries to discern automotive OEMs' perspectives on critical aspects of the industry. For example:

'Which price would automated cars be in comparison to a normal car?'

This question is specifically aimed at gauge their perception of acceptable price ranges among consumers. Utilizing fixed response options such as 1-10%, 10-20%, etc., the answers help us gather insights into OEMs' pricing strategies and market expectations.

'From 1 to 5, how do you as a representative of your company think automated cars will be accepted by customers?'

'From 1 to 5, how concerned are you, as a representative of your company, over safety issues of automated cars?'

Here, the survey uses scaled questions to gauge OEMs' perceptions of customer acceptability and safety issues related to AVs. The level of confidence and uncertainty among OEM representatives can be determined by asking them to rate their answers on a scale of 1 to 5, which provides important information about the general attitudes in the industry. The survey provides respondents with greater flexibility to express their opinions and insights in a unique way in the unstructured part of the questionnaire. The goal with open-ended questions is to get more specific and targeted answers from OEMs. For example:

'What can motivate/hinder your company to manufacture and sell automated cars?'

The survey asks them about the main motivations and challenges affecting their decision-making when it comes to manufacturing and distributing AVs. This helps to obtain important insights into the intricate dynamics influencing respondents' strategic considerations in this area by asking them to describe the main opportunities and challenges they face.

'What are the three most important aspects to solve/improve in order to accelerate the development of automated cars?'

'Which kinds of partners are essential for your company when you think of automated cars?'

In the same way, the survey probes OEMs to determine the top three key problems that need to be resolved in order to accelerate the development of AVs, with the goal of identifying important areas of focus and priorities within their innovation strategies. The survey also aims at understanding their views on the kinds of partnerships that are necessary to successfully navigate the shift to AVs. Understanding that this is a collaborative endeavour, the goal is to comprehend OEMs' partnership preferences and strategic imperatives, including joint ventures and collaborations with technology startups, in order to address the complex challenges that come with this transformative shift. The survey aims to gather a variety of viewpoints and insights with these unstructured questions in order to improve our comprehension of the changing automotive industry and guide strategic decision-making. It probes further into their position regarding shared mobility, including views on use, adoption both internally and externally, accessibility, engagement inclination, pricing policies, and related issues. In the structured portion of this section, the survey takes a uniform stance in order to understand OEM viewpoints on sha red mobility, which reflects the industry's shift from ownership-to usage-based BMs. For example:

'From 1 to 5, how willing is your company to use sharing services?'

In order to obtain an understanding of OEMs' readiness to adopt shared mobility solutions, the survey uses scaled questions to assess their willingness to using sharing services, like carpooling and rentals.

In the future, the survey continues to explore OEMs' viewpoints on Mobility-as-a-Service (MaaS) and new BMs, paying particular attention to how they integrate digitally, the advantages they see, the difficulties they face, and the effects they expect. Moving on to talk about car subscription and data monetization models, the survey aims to understand how they affect sales and revenue streams, key characteristics, service bundling strategies, partnership opportunities, and potential roadblocks. With a focus on adaptability and flexibility, the questionnaire seeks to gather OEMs' complex perspectives and strategic plans in the context of the changing automotive industry, making use of their natural advantages in R&D, market flexibility, and technological innovation. By using this customized approach, the survey looks at obtaining thorough insights that educate industry stakeholders and guide strategic decision-making in the interest of innovation and sustainable growth. For example:

'MaaS offers a wide range of opportunities to explore and set targets on. Which of the following are the most important benefits of MaaS according to your company?'

A series of options pertaining to potential revenue streams, collaborations, ecosystem expansion, sustainability initiatives, and other relevant benefits are presented after this question. Selecting the options that respondents believe offer the biggest advantages of MaaS for their business is requested of them. Once the responses have been studied, a clear understanding can be made of the benefits OEMs value most. With the help of this information, the particular areas that business leaders find most important can be investigated. Research and strategic efforts can be focused on investigating

these areas more thoroughly and finding new opportunities for growth and innovation by having a clear understanding of these priorities. By using this method, MaaS offerings can be customized more efficiently to meet OEMs' requirements and expectations, increasing the likelihood of successful adoption and deployment.

'According to you, which of the following are the toughest challenges a company faces while implementing MaaS solutions?'

A set of choices that address data privacy, data security, user awareness, technology dependence, regulatory compliance, and infrastructure readiness are presented after this question. Researchers can determine the primary concerns and obstacles that OEMs consider important when it comes to MaaS ideation and deployment by looking at the options that respondents chose. Comprehending these obstacles is essential to coordinating research and development efforts towards the discovery of effective solutions. For instance, R&D can concentrate on creating strong encryption techniques and safe data management procedures if data privacy and security are emphasized as the main concerns. In the same way, efforts can be focused on developing educational campaigns and enhancing the dependability of technological infrastructure if user awareness and technology dependence are considered to be major challenges. By taking a focused approach, it is ensured that MaaS solution development is proactive and responsive to OEMs' real needs and concerns. By taking care of the most important issues, it can be made sure that MaaS easier to deploy and more widely accepted, which will ultimately help to advance creative and sustainable mobility solutions. The survey then goes into further detail about particular BMs that MaaS can drive. Researchers can learn more about the potential and viability of "vehicle subscription" and "data monetization" BMs by obtaining an understanding of the viewpoints of business leaders in the automotive OEM industry. The purpose of the section on subscription services for vehicles is to learn what OEMs think about the uptake and scalability of these services. Automobile OEMs have been exploring subscription services, an important topic that aims to find out how they think their customer base views usage-based models. Customers of today are drawn more and more to these models because of their flexibility and convenience; they would rather not deal with the hassle of long-term commitments and the associated formalities. For example:

'What are the most important aspects [most important to least important] when introducing subscription services as a business model?'

'What are the primary concerns or challenges in considering subscription models for OEMs?'

The survey used a ranking approach for this question, asking participants to rank different factors in order of importance. Researchers can better understand the components OEMs deem essential to the introduction and upkeep of successful subscription services within their portfolio by using this approach. Researchers can determine the critical elements that will propel the success of subscription services by examining these rankings. The OEMs' rankings will clearly outline the strategic reasoning for subscription services. Industry experts can guarantee that subscription services develop in a way that benefits OEMs and their customers by concentrating innovation and research efforts on these crucial components. Setting these important factors first will direct the creation of subscription models that satisfy OEMs' demands for profitability and market distinction and customer preferences for flexibility and convenience. This focused strategy will make it easier to develop strong subscription services that satisfy the needs of contemporary consumers and promote long-term financial success for automotive OEMs. Since subscription services are still in their infancy in the automotive sector, OEMs continue to be concerned about the possible difficulties and risks involved in their adoption and maintenance. Respondents are also asked to list the difficulties they believe to be the main barriers to

using subscription services in the survey. Researchers and industry professionals can concentrate their efforts and resources on creating optimal solutions to effectively address these issues by having a thorough understanding of these concerns. The lack of thorough exploration of various components of subscription services is the root cause of many of these challenges. OEMs are reluctant to include this business model in their portfolios as a result. Vehicle manufacturing and distribution have always been the primary objectives for OEMs. It is uncertain whether new BMs, such as subscription services, will ultimately succeed because they require more work and effort from current employees. Additionally, the move to subscription models calls for major adjustments to customer support, operations, and technology integration. OEMs need to make sure that both their personnel and their infrastructure are prepared to handle these new services. Layers of complexity and possible risk are added by this. Through focused research and innovation, OEMs can better navigate the transition, ultimately enhancing their ability to offer attractive and viable subscription services to their customers. The survey utilizes a comparable methodology to explore data monetization models within the automotive sector. Its main goal is to identify the most significant factors and possible challenges that might arise when attempting to monetize data generated by vehicles. Businesses must devote a large amount of time and energy to understanding and controlling a variety of complexities associated with data monetization, such as regulatory compliance, data breach prevention, and data security. Furthermore, businesses need to keep up with changes in government regulations and invest a significant amount of money to develop technologies that can handle enormous volumes of data and guarantee secure storage. This entails building a solid data infrastructure, putting cutting-edge cybersecurity measures in place, and making sure that ever-changing data protection laws are followed. For example:

'According to you, which factors are the most important to be considered when introducing a data monetization model?'

This question is accompanied by a variety of options related to regulatory compliance, data security, technological infrastructure, ethical considerations, and market demand. In addition to choosing from these options, respondents can offer other insights that might not be specifically mentioned. Through the participation of leading OEMs in this study, we, as researchers, hope to obtain a thorough grasp of the elements that are thought to be essential for data monetization in the automotive sector. Researchers will be able to determine from this data which components are most important to leaders in the industry, providing important insights into OEMs' strategic priorities and real-world considerations for monetizing vehicle-generated data. Researchers and industry professionals can focus their efforts on addressing the most crucial opportunities and challenges in data monetization by having a clear understanding of these key variables. The monetization of data presents a significant opportunity to create supplementary revenue streams, especially considering the advanced connectivity attributes found in modern day passenger and commercial vehicles. Effectively handling and utilizing this data can create new opportunities for OEMs to work with customers and partners who are eager to obtain important vehicle and surrounding data. By doing this, businesses can strengthen their core operations while also generating a sizable amount of additional revenue to reinvest. This might involve more developments in vehicle technology, better customer support, and increased market competitiveness all around.

'What are the concerns/barriers that the company would have to tackle when planning to introduce a data monetization model? Please rank them 1 being the biggest barrier and 10 being the lowest barrier.'

This question adopts a unique approach to understand the significant challenges that automotive OEMs foresee when it comes to monetizing vehicle data. Respondents are asked to rank these

concerns from 1 to 10, with 1 being the most formidable challenge. By having respondents prioritize these challenges, the survey aims to pinpoint the most pressing issues that industry professionals believe need to be addressed. This information is essential for directing research efforts in the direction of effectively mitigating these issues. Professionals in the industry can learn more about the precise technology requirements, data strategies, and possible collaborations that are required for successful data monetization. Additionally, entrepreneurs aiming to create data-focused startups can learn a lot from this approach. They can identify crucial areas in need of creative solutions and create goods or services that specifically address these challenges by knowing the ranked barriers. Furthermore, this data can aid in outlining a broad schedule for obtaining the assets and competencies required for successful data monetization models.

Furthermore, the research aims to explore similar topics for other stakeholders - PTPs and SMCs. Although the research focuses mainly on understanding OEM perspectives, it also looks at other stakeholders that are a part of the automotive ecosystem. Understanding how various stakeholders view these issues, opportunities, and challenges in different ways is an important objective. Through the analysis of these perspectives, researchers can learn how different stakeholders perceive the mobility landscape, revealing possible areas for collaboration as well as consumer preferences and technological needs. Industry professionals can gain valuable insights from this thorough analysis, which looks at both past and future trends. Recognizing these patterns can aid in locating potential areas of cooperation between various stakeholders, resulting in alliances that capitalize on the advantages of each of them. For instance, PTPs and SMCs might find common ground in integrating their services to offer more seamless and sustainable urban mobility solutions.

5.1.2 For public transportation providers

Different stakeholders in the automotive industry must address distinct issues pertinent to their roles and objectives. As researchers, the author has modified the questionnaire designs in the context of this thesis in order to address the particular issues and concerns that are pertinent to each stakeholder. For example, PTPs must consider broader market trends and consumer preferences, whereas automotive OEMs may concentrate on the technical aspects of autonomous driving and the financial implications of new BMs like vehicle subscription and data monetization. The regulatory environment, accessibility, and affordability of their services, as well as the integration of shared mobility services, should be given top priority by PTPs. They also need to be sensitive to the changing needs of urban populations, who are calling for more eco-friendly and effective transportation options. The objective of the questionnaire was to gather information from PTPs in order to address the research questions of the thesis, while maintaining the general idea of the questions and going into more specific details. Considering a number of factors, including the bureaucratic framework of transport organizations, the intricacy of decision-making processes, and the heavy demand on their time and resources, it became clear that this category of stakeholders was the hardest to approach. These elements frequently lead to low availability and responsiveness to survey responses. The author contacted 17 different European public transportation companies, primarily in Germany, France, and Austria. It was difficult to locate relevant professionals and get responses. The author decided to try a different strategy after contacting 30 people at these PTPs and not getting a response that seemed satisfactory. In order to overcome this obstacle and maximize the number of participants, we, as researchers, refocused our efforts on more accessible public transportation options in the Austrian region. This helped in maintaining frequent follow-ups via phone calls, emails, and other online communication channels by concentrating on a specific geographical area. By using this approach, a more regular channel of communication was created, and it helped in collecting as much useful data as possible, guaranteeing that the research would continue to profit from the important insights provided by this stakeholder group. An example of how the questionnaire was modified according to the stakeholder category:

'What can motivate your organization to use automated vehicles in public transport? Please rank them according to your preference.'

Respondents are given choices in categories such as safety, costs, and comfort, helping us identify the most critical factors for PTPs when considering the use of AVs. These priorities differ from those of OEMs, reflecting the unique concerns and motivations of public transport stakeholders. Similar to the questions designed for OEMs, this questionnaire aims to understand the motivations, challenges, and partnership strategies that PTPs need to address, given the potential rise in popularity of AVs in the near future.

'As a representative of your organisation, do you think automated vehicles bring any social values?'

Given the diverse demographic of urban residents who primarily use public transportation, this question is specifically directed at the public transportation sector. These residents include, among others, senior citizens, students, physically disabled people, and people from socially disadvantaged backgrounds. Providers of public transportation have a unique opportunity to improve everyone's accessibility and mobility, reduce traffic, increase safety, lower environmental impact, and provide better and more reliable transportation options. They may be able to increase public interest in using public transportation by incorporating AVs. It is essential to comprehend how stakeholders view the social impact of AVs. It clarifies their objectives and goals when planning to acquire more customers. In urban areas, where residents frequently own private vehicles and have access to shared mobility services, PTPs need to devise a strategic plan to draw in more users. Public transportation companies can establish themselves as the better option in a competitive marketplace by highlighting the social benefits of AVs, such as improved accessibility and safety. This strategic approach makes public transportation a more sustainable and inclusive choice for residents of cities, while also aiming to increase customer engagement and align with wider societal goals.

'As a representative of your organisation, what is your view on sharing services integrated into public transport?'

By providing users with more flexibility and convenience, integrating sharing services into public transportation can significantly enhance the ecosystem surrounding mobility as an entire sector. However, there are a number of challenges with this integration that PTPs may or may not choose to deal with. The establishment of multi-modal hubs, seamless transfers, infrastructure support, cooperative campaigns, and uniform user interfaces can all lead to effective integration. To create a cohesive service, SMCs, data and technology companies, and PTPs have to collaborate together. These partnerships seek to reduce wait times, enhance user experiences, and make it simple to change between various forms of transportation. Given the substantial time and resources required for this task, this question seeks to understand whether PTPs are willing to consider such a collaborative approach. It also aims to identify the potential benefits and challenges from the perspective of PTPs, thereby providing insights into their readiness and strategies for integrating shared mobility services into their existing systems. This information is vital for stakeholders aiming to develop effective and sustainable mobility solutions.

'Do you think the company can explore new mobility offerings to increase customer engagement and encourage people to choose public transportation over personal vehicles? If yes, what options could be successful in the near future?'

This question is considered crucial as it seeks to understand the stakeholders' mindset on exploring new BMs and mobility offerings. Given the innovative approaches being adopted by companies, it is essential for PTPs to evolve beyond traditional business methods. They need to incorporate better

ticketing options and enhanced services. The question is followed by a number of checkboxes related to personalization, digital wallets, environmental initiatives, membership and reward programs, etc. Respondents can check the boxes they feel could help keep the general public engaged. From the answers, the author gained an overview of the strategies that PTPs are planning to implement. This insight also reveals their mindset—whether they still rely on traditional business methods or are willing to embrace modern initiatives. By analysing these responses, the author can better understand how PTPs aim to innovate and attract more customers, ensuring their services remain competitive in an evolving market.

'Do you think subscription models can help address the changes in customer preferences or demands for flexible transportation options?'

This question aims to understand the perspective of PTPs on subscription models and their feasibility. It seeks to determine if PTPs have a clear understanding of subscription models and their potential for implementation. Additionally, the question helps gauge whether PTPs are aware of the evolving customer preferences and mindsets, and the demand for more flexible transportation options. By exploring these aspects, the author can gain insights into how well PTPs are adapting to changing market dynamics and whether they see subscription models as a viable solution to meet the diverse needs of modern commuters. This understanding is crucial for identifying opportunities for innovation and ensuring that public transportation remains a competitive and attractive option in an increasingly flexible and customer-centric market.

Finally, the questionnaire has been modified to specifically address SMCs, focusing on their unique concerns, opportunities, and strategies. Following a similar pattern to the one used for PTPs, the author conducted thorough research to identify crucial information pertinent to shared mobility and shared services, particularly fleet-related data. This approach allowed us to gauge the trajectory and strategic direction of SMCs.

In today's world, especially with the trends favoured by the younger generation, shared mobility is rapidly gaining popularity. It is emerging both as standalone entities and as integrated BMs within OEMs. Understanding the views of these stakeholders is essential for conducting a significant investigation into potential outcomes, innovative ideas, partnership opportunities, and new revenue streams

5.1.3 For shared mobility companies

The shared mobility industry is changing swiftly due to rising urbanization, advancing technology, and shifting consumer preferences. Car sharing, bike sharing, scooter sharing, and ride-hailing services are some of the essential elements of shared mobility. The growing challenges of urban congestion are driving the potential of shared mobility to expand into new cities and regions. By putting operational safety first, integrating cutting-edge technologies promises to transform service efficiency and improve the user experience overall. Promoting EVs (EVs) in line with sustainability initiatives will help stakeholders gain more funding and support as consumers and governments become more environmentally conscious. Building integrated transport systems that provide smooth, multimodal journeys and support sustainable urban mobility ecosystems requires cooperation between SMCs, PTPs, and urban planners. In this ever-changing shared mobility landscape, adaptable BMs—such as subscription services and bundled mobility packages—are essential for meeting the needs of a wide range of users and guaranteeing increased customer loyalty and retention. The author reached out to 26 various SMCs, including some associated with automotive OEMs. To boost participation, the authorcontacted 47 individuals primarily engaged in mobility solutions and business development. Through diligent follow-ups and reminders, the author garnered responses from 7 companies, gaining

insights into their perspectives on autonomous and shared mobility, as well as their associated BMs. The questionnaire sent out to shared mobility and related stakeholders aims to understand the overall market they are trying to capture, as well as the trends they are creating. For example:

'As a representative of your company, how do you think automated cars will affect the service costs of your fleet?'

This inquiry seeks to delve into your company's stance on adopting AVs into your fleet and the financial implications it entails. While the adoption of AVs promises reductions in driver-related expenses, enhancements in safety and reliability, it also poses substantial upfront investments for integration. This transition is expected to incur additional operational expenses such as software upgrades, technology maintenance, training expenditures, as well as considerations regarding safety and liability. These factors are pivotal in determining whether SMCs opt to incorporate AVs into their fleets. Thus, gaining detailed insights on how your company perceives this prospect is crucial.

'What are the three most important aspects to solve/improve in order to increase the success of sharing services? Please answer with just one catchword per aspect – Rank them by priority, starting with the most important one.'

The responses to this question will give important information about the future of sharing services as perceived by companies involved in shared mobility. The answers will emphasize important elements that stakeholders think are necessary for sharing services and related BMs to succeed. These crucial elements can direct industry experts and researchers in concentrating their efforts, helping to broaden the shared mobility ecosystem, since sharing services have not yet been thoroughly investigated. It is vital to prioritize affordability, sustainability, and accessibility in order to boost the uptake of sharing services. Improving accessibility requires availability at all times, wide geographic coverage, easy-to-use platforms, and convenient access points. Competitive pricing, adaptable pricing structures, cost effectiveness, collaborations, and subsidies are all necessary to increase affordability. Putting a focus on sustainability entails making long-term strategy development, community engagement, adoption of sustainable practices, and fleet investments that are environmentally friendly. SMCs can boost the attractiveness, usability, and general success of their services by taking care of these factors, which will encourage growth and adoption within the shared mobility ecosystem.

'How do you think sharing services will affect public transport costs?'

This question aims to understand stakeholder perceptions of the overall cost structure of mobility. As highlighted in the literature section of the thesis, 'price' is a major factor influencing consumers' choice of transport mode. Affordable and accessible shared mobility options can encourage the public to use these services more frequently, prompting PTPs to rethink their pricing strategies. Shared mobility offers advantages over traditional public transport, such as greater comfort, reduced travel time, and the elimination of station-based constraints. Consequently, PTPs may need to reduce their costs to attract more customers. The responses to this question will provide insights into industry experts' views on costs and whether they believe these changes will positively or negatively impact public transport costs.

'What are the most important technology and software solutions that your company will need to develop or adopt to support subscription management, booking, and customer interactions?'

Subscription models are likely to be widely implemented by SMCs, as managing these models is a core function for them. SMCs typically acquire vehicle fleets from OEMs, freeing them from concerns about manufacturing, distribution, or maintenance of the vehicles. This allows them to allocate more time,

money, and resources to innovative BMs focused on customer satisfaction. The question is followed by a series of options related to customer satisfaction, including technological and software ideas for fleet management, mobile applications, digital and flexible payment opportunities, geolocation and mapping services, data management, third-party services, data analytics, etc. Responses will help us understand how well stakeholders address customer preferences and identify the key factors or services influencing customers' decisions to opt for sharing services. If a particular technology or software solution is frequently highlighted, researchers can focus on that domain to develop better solutions.

'According to you, what factors would be important to increase market penetration and urge customers to use the subscription and other services from car rental/ car sharing/ car-pooling companies?'

This question is followed by a series of options covering broad topics like pricing, value proposition, customer service, and sustainability, as well as niche topics such as marketing strategies, last-mile connectivity, and safety measures. The primary goal is to understand how shared mobility companies plan to enhance market penetration, improve customer service, and maximize revenue. The questionnaire also provides respondents the opportunity to add additional points if certain factors have not been specified. Gaining deep insights into the transition from ownership to usage-based models is a crucial task. Detailed responses from industry experts, who deal with these topics daily, will provide valuable information for researchers. These insights will help in refining and improving subscription models and contribute to the broader understanding of the factors driving the success of shared mobility services. This knowledge is essential for developing strategies that effectively meet customer needs and preferences, thereby fostering the growth and adoption of shared mobility solutions. Following the completion of designing a comprehensive survey/questionnaire and engaging with stakeholders, the thesis progresses to the 'Data Collection' phase.

5.1.4 Data collection process

The entire data collection procedure involving the three stakeholder groups is described in this subsection. Using a variety of techniques, including phone calls, administrative office mail, company emails, professional emails, and online channels, was part of the strategy to involve stakeholders. Every technique was used with purpose to guarantee thorough coverage and efficient communication. Through this process summary, the author hopes to give the reader a clear understanding of how data was gathered from each stakeholder group, emphasizing the methodical approach and variety of channels used to obtain insightful and robust responses.

To select OEM, PTP, and SMC partners for the survey, an elementary yet valuable set of criteria was applied. The literature review and a number of key performance indicators specific to each kind of partner served as guidelines for this selection process. For OEMs, the criteria included:

- Industry Influence: The extent to which the OEM impacts the automotive industry.
- Company Size: The overall size and capacity of the OEM.
- Operations in Europe: Whether the OEM has significant operations in Europe.
- Market Share: The proportion of the market that the OEM commands.
- Product Range and Diversity: The variety and breadth of products offered by the OEM.

For PTPs, the criteria focused on:

- Service Type: The specific types of public transport services offered.
- Coverage Areas: The geographic areas served by the PTP.

- Accessibility: How easily accessible the services are to the public.
- Willingness to Collaborate: The PTP's openness to participate in the survey and collaborate on research.
- Reputation and Past Performance: The PTP's standing in the industry and its historical performance.

For SMCs, the criteria included:

- Market Presence: The visibility and influence of the shared mobility service in the market.
- Fleet and Infrastructure: The size and quality of the service's vehicle fleet and supporting infrastructure.
- User Engagement: The level of interaction and engagement with users.
- Diversity of Mobility Solutions: The range of mobility solutions provided, such as car sharing, bike sharing, and ride-hailing.

By considering these criteria, the selection process ensured that the chosen partners were relevant, influential, and capable of providing valuable insights for the survey. This comprehensive approach aimed to capture a diverse and representative sample of the industry, facilitating a thorough and meaningful analysis.

Fig.27, Fig.28, and Fig.29 provide a general overview of the data collection process, including how information was tracked, whether follow-ups were conducted, and how queries were addressed. To facilitate ease of understanding, the author presents a general overview of our process, as it was consistently applied to 33 different OEMs, 17 different PTPs, and 26 different SMCs. Similarly, other OEMs, PTPs, and SMCs were contacted, and one or two follow-up rounds were conducted. In most cases, it became clear after two follow-ups whether the company was interested in responding to the survey or had already responded.

OEMs	Contacted	Date	Follow-up 1	Date	Follow-up 2	Date	Response received
OEM1	y	02-11-2023	y	16-11-2023	n/a	-	y
OEM2	y	02-11-2023	n/a	-	n/a	-	n
OEM3	y	02-11-2023	y	16-11-2023	y	07-12-2023	y
OEM4	y	02-11-2023	y	16-11-2023	y	07-12-2023	y
OEM5	y	02-11-2023	y	16-11-2023	y	07-12-2023	n
OEM6	y	03-11-2023	n/a	-	n/a	-	n
OEM7	y	03-11-2023	y	17-11-2023	y	08-12-2023	y
OEM8	y	03-11-2023	n/a	-	n/a	-	n
OEM9	y	03-11-2023	y	17-11-2023	n/a	-	y
OEM10	y	06-11-2023	y	20-11-2023	y	11-12-2023	n
OEM11	y	06-11-2023	y	20-11-2023	y	11-12-2023	n
OEM12	y	06-11-2023	y	20-11-2023	y	11-12-2023	y

Fig. 27. Data Collection process for OEMs

PTPs	Contacted	Date	Follow-up 1	Date	Follow-up 2	Date	Response received
PTP1	y	06-11-2023	y	20-11-2023	y	04-12-2023	y
PTP2	y	06-11-2023	y	20-11-2023	y	04-12-2023	n
PTP3	y	06-11-2023	n/a	-	n/a	-	n
PTP4	y	08-11-2023	y	22-11-2023	y	05-12-2023	n
PTP5	y	08-11-2023	y	22-11-2023	y	05-12-2023	n
PTP6	y	08-11-2023	y	22-11-2023	n/a	-	n
PTP7	y	09-11-2023	y	23-11-2023	y	06-12-2023	n
PTP8	y	04-12-2023	y	08-01-2024	n/a	-	n
PTP9	y	04-12-2023	y	08-01-2024	y	22-01-2024	y
PTP10	y	05-12-2023	y	09-01-2024	y	23-01-2024	y
PTP11	y	05-12-2023	y	09-01-2024	y	23-01-2024	n
PTP12	y	05-12-2023	y	09-01-2024	y	23-01-2024	y

Fig. 28. Data Collection process for PTPs

SMCs	Contacted	Date	Follow-up 1	Date	Follow-up 2	Date	Response received
SMC1	y	09-11-2023	y	23-11-2023	y	04-12-2023	y
SMC2	y	09-11-2023	y	23-11-2023	y	04-12-2023	y
SMC3	y	09-11-2023	y	23-11-2023	n/a	-	n
SMC4	y	10-11-2023	n/a	-	n/a	-	n
SMC5	y	10-11-2023	y	24-11-2023	y	05-12-2023	y
SMC6	y	10-11-2023	y	24-11-2023	n/a	-	n
SMC7	y	10-11-2023	y	24-11-2023	n/a	-	n
SMC8	y	13-11-2023	y	05-12-2023	n/a	-	n
SMC9	y	14-11-2023	y	05-12-2023	y	09-01-2024	y
SMC10	y	14-11-2023	y	05-12-2023	y	09-01-2024	n
SMC11	y	05-12-2023	y	09-01-2024	y	23-01-2024	y
SMC12	y	05-12-2023	y	09-01-2024	y	23-01-2024	y

Fig. 29. Data Collection process for SMCs

Stakeholder	Number of company's approached	Responses received
OEMs	33	10
PTPs	17	6
SMCs	26	7
Total	**76**	**23**

Table 1. Number of responses received from the stakeholders

5.1.5 Data analysis: Gathering, processing and categorizing the data

According to Sabah, et al. (2022), the gathering of data is crucial to accurately representing the available knowledge. Sabah, et al. (2022) also states that all studies primarily cover the two categories of data sources in order to give readers a thorough grasp of both qualitative and quantitative research. Primary data sources, also known as first-hand data sources, collect information about an issue that is currently facing society.it is derived from firsthand accounts, interviews, and original documents. A few instances of primary data-generating activities include lab tests, observational data recording, survey administration, and survey design. On the other hand, historical data such as company financial reports, annual reports, and economic surveys and statistics are used to obtain secondary data sources.

In context of this thesis, data analysis was carried out in the following steps:

Step 1: Data Compilation - The initial step involved compiling the collected data from the survey questionnaires and Google Forms. This process resulted in the creation of three comprehensive data sheets, each containing combined data from all three stakeholder groups.

Step 2: Data Transformation - Subsequently, the collected data was transformed into a suitable format for analysis. This transformation ensured that the data was structured and organized in a way that facilitated meaningful analysis and interpretation.

Step 3: Data Cleaning - Thorough data cleaning procedures were implemented to address any discrepancies, duplicates, or inconsistencies in the dataset. This meticulous cleaning process was crucial for ensuring the accuracy and reliability of the data.

Step 4: Comparative Analysis - A comparative analysis was conducted to assess the distribution of data across the different stakeholder groups. The sample sizes for each stakeholder were considered, and particular emphasis was placed on identifying the most important questions from the survey. These key questions served as the basis for deriving interview questions, particularly focusing on the two important BMs highlighted in the thesis.

Step 5: Data Categorization - To facilitate ease of analysis and understanding, the collected data underwent a categorization process. Responses were analysed and categorized into specific themes or topics. For instance, if stakeholders provided responses related to technology such as 'tech, tech requirements, adv tech, etc.', these were cumulated under a single category labelled 'Technology readiness'. This categorization helped streamline the data analysis process and provided a clear structure for interpretation.

Step 6: Interpretation of Results - Finally, the interpreted results were analysed to derive meaningful insights and conclusions. This interpretation phase involved synthesizing the categorized data, identifying trends or patterns, and drawing conclusions that addressed the research objectives outlined in the thesis.

5.2 Uncovering insights: Exploring stakeholder perspectives in depth through interviews

Surveys are a useful tool for gathering quantitative data from an extensive population, but interviews have distinct advantages of their own, including deeper investigation, contextual understanding, response clarification, uncovering unexpected themes, personal connection, customized approach, and data triangulation (Irvine, 2018). Researchers can improve the validity and reliability of research findings by gaining a thorough understanding of stakeholders' perspectives, behaviours, and experiences by combining interviews with surveys. Interviews are essential for gaining nuanced insights and comprehending the intricate dynamics influencing the future of the automotive and mobility industries, especially when viewed through the lens of CASE mobility. Through interviews, researchers can interact with important stakeholders, such as business leaders, policy makers, and technological innovators, to learn more about their viewpoints, past experiences, and approaches to CASE mobility. Researchers can learn about market dynamics, technological developments, industry trends, and regulatory issues through interviews that may not be immediately clear from surveys/questionnaires alone. Furthermore, interviews facilitate the exchange of firsthand knowledge, anecdotal evidence, and visionary insights among stakeholders, thereby augmenting our comprehension of the advantages and challenges linked to CASE mobility. Researchers can obtain a

comprehensive understanding of the automotive and mobility landscape by utilizing interviews in conjunction with other research methods. This understanding can then be used to inform strategic decision-making, policy development, and innovation in the search for sustainable and inclusive mobility solutions.

As previously mentioned, in addition to the surveys, two interview sessions were conducted with representatives from the OEM stakeholder group. These interviews were held using the online tool Microsoft Teams. Since both interviewees were based in Europe, there were no issues with time zones. Drawing on valuable insights from the surveys and picking topics that required detailed information, the interviews were limited to 13 questions and lasted 30 minutes. Given the time constraints, the interviews focused on in-depth questions about 'vehicle subscription models' and 'data monetization models' for the automotive industry, so RQ3 and RQ4 from our research questions, covering both the passenger vehicle market and the commercial vehicle market. Therefore, the interview guidelines and questions were specifically derived from RQ3 and RQ4. To encourage fuller responses and potentially gain important explanations or interesting stories, it is often best to ask questions that cannot be answered with a simple “yes” or “no,” unless a very clear or precise answer is required (University Writing Center, 2014). The structure of the interviews was designed as suggested by a guide from Harvard University (2023). As suggested by the guide, a blend of ‘direct questions’, ‘indirect questions’, ‘follow-up questions’, ‘interpreting questions’ etc. was used.

The interview was divided into four sections: an introduction to the main topics, a discussion on sub-topics closely related to these areas, an exploration of opportunities and threats, and a final conclusion that includes future trends and innovations.

- Introduction to the main topics – vehicle subscription and data monetization

  ‘How familiar are you with the concept of vehicle subscription models, and what is your idea about these business models?’
  It is important to know if OEMs are aware of vehicle subscription models and their approaches. This sets the tone for the interview because the questions and information that follow will build on their understanding of this relatively new BM. By establishing this baseline, the author can examine their approaches' intricacies and efficacy in greater detail, as well as their ability to adjust to changing market demands.

  ‘How familiar are you with the concept of vehicle data monetization models, and what do you think about including it as an additional revenue generation BM in your portfolio?’
  It is crucial to know if well-known and conventional OEMs are aware of the growing field of data monetization. This inquiry will set the tone for our conversation and help us determine how aware and prepared they are. The author can then go deeper into specific inquiries regarding data handling, storage, consent from customers, data security, and other relevant subjects from this starting point. By creating this baseline, the author can make sure that, in the increasingly data-driven landscape, there can be a thorough discussion about their strategies and practices.

- A discussion on sub-topics – competitive advantage, business opportunities etc.

  ‘What differentiates vehicle subscription service from traditional leasing or rental services?’
  The purpose of this question is to determine how well OEMs understand the distinctions between traditional leasing and renting services and subscription models for cars. It seeks to

ascertain how thoroughly they understand these ideas. With this basic understanding, the author can go on to ask OEMs more detailed questions concerning these models, delving into details like flexibility, digitalization, and other subtleties. The author can evaluate their preparedness and strategic approach to implementing these concepts in the dynamic mobility landscape by gaining an understanding of the breadth of their knowledge in these areas.

'How do you see the subscription model evolving in the next 5-10 years?'
This inquiry seeks to determine OEMs' acceptance of subscription services as well as their expectations for the near future. The author can more accurately predict whether OEMs' views on subscription services will grow or stay the same in the upcoming years by asking these individuals about them. Furthermore, investigating OEM viewpoints can yield insightful information about possible problems that either already exist or might develop in the future. Examining these details in-depth during the interview can provide a thorough understanding of the landscape, given their in-depth knowledge of consumer preferences and market insights.

'How do you measure the financial success of a subscription model that a company might implement?'
This question provided insightful information about how OEMs evaluate the performance and financial sustainability of a subscription model, as well as the essential metrics and indicators they use to gauge success. OEMs use a variety of metrics, such as total revenue, profitability, and rates of customer acquisition and retention, to determine the financial viability of their business strategy. These metrics provide researchers and mobility specialists with diagnostic tools in addition to benchmarks for assessing the model's effectiveness. Through a thorough examination of these variables, interested parties can identify opportunities for enhancement and identify the root causes of any stagnation in the subscription model.

'What types of data are collected from your vehicles, and how is this data utilized? What value-added services can be developed using the data collected from vehicles?'
Asking an OEM representative this question can provide insight into the kinds of data that are gathered from cars (performance, usage, location, driver habits, etc.), how they are used (predictive analysis, performance optimization, etc.), and what value-added services (fleet management, remote monitoring, etc.) are created with this data. It displays how the OEM uses data, its capacity for innovation, and the real advantages that consumers receive from data-driven services.

'Has your company identified any lucrative opportunities for data monetization? How do partnerships with other companies (e.g., tech firms, insurance providers) enhance any data monetization strategy?'
Asking this question can reveal whether the OEM has found profitable ways to monetize data (such as targeted advertising, aggregated data insights, etc.) and how partnerships with tech companies or insurance providers support their approach. The representative could talk about joint ventures to take advantage of complementary skill sets, break into untapped markets, or co-create cutting-edge data-driven goods and services. Opportunities found within their business model, teamwork to maximize data value, and tactics for innovation and market differentiation are a few examples of insights.

- Questions related to opportunities and threats in the vehicle subscription and data monetization landscape

  'How can vehicle subscription models enhance customer engagement and satisfaction compared to traditional ownership models? Are there specific market segments or regions where you believe vehicle subscription models would be particularly well-received?'
  By posing the question to an OEM representative, researchers can learn more about the OEM's viewpoint on potential advantages and target markets for car subscription services. The OEM's comprehension of customer preferences and market dynamics, along with their strategic considerations for implementing subscription models, can be discerned from the response. The OEM's opinions on how subscription models improve customer engagement, satisfaction, and loyalty over traditional ownership models, as well as their evaluation of market niches or geographical areas where subscription models would be most feasible and well-received, can all be included in the insights that are gained. Researchers can use this data to gain in-depth understanding of consumer preferences, market opportunities, and possible future growth and innovation areas in the automotive sector.

  'What opportunities do you see in monetizing vehicle data for generating additional revenue streams and enhancing customer experiences? Are there untapped markets or industries where you believe your data assets could create significant value through partnerships or collaborations?'
  Researchers can gain insight into the OEM's strategies for using vehicle data to boost revenue growth and enhance customer experiences by posing this question to an OEM representative. The OEM's perspective of the opportunities offered by data monetization can be discerned from the response, which can also reveal unexplored markets or industries in which data assets have the potential to generate substantial value through partnerships or collaborations. Scholars can acquire knowledge about the OEM's creative methods of using data, possible forays into untapped markets, and strategic partnerships designed to optimize the earnings potential of their data assets. Researchers can use this data to learn more about the OEM's innovative strategies, competitive positioning, and potential future growth within the automotive sector.

  'What happens if the consumers do not accept subscription models? How feasible is it to implement vehicle subscription models and reverse them if they do not meet OEMs' expectations?'
  By posing the question to an OEM representative, researchers can gain insight into the backup plans and risk mitigation techniques that are put in place in case customers disapprove of subscription models. The OEM's readiness for future obstacles and their adaptability to market feedback can be inferred from the response. Researchers can acquire knowledge regarding the viability and possible consequences of introducing and withdrawing subscription models. Researchers can learn from this data about the OEM's flexibility, resilience, and strategic decision-making processes in response to changes in the automotive industry's market dynamics.

  'What are the potential risks or vulnerabilities associated with monetizing vehicle data, such as data privacy concerns or cybersecurity threats? How do you ensure transparency and trust with customers regarding the collection and use of their vehicle data for monetization purposes?'

Researchers can learn more about an OEM's comprehension of the possible risks and vulnerabilities related to data monetization in the automotive industry by raising this question to an OEM representative. The OEM's strategies for ensuring transparency and fostering customer trust regarding the collection and utilization of vehicle data, as well as their approach to reducing cybersecurity risks and privacy concerns, can all be gathered from the response. In a market that is becoming more and more data-driven, researchers can learn much about the OEM's dedication to data protection, regulatory compliance, and customer privacy. These are important aspects of preserving consumer trust and brand reputation.

- Conclusive questions regarding innovation and future trends

  'Does your company plan to innovate and differentiate vehicle subscription models in response to evolving customer preferences and market trends? How does your company plan to stay ahead of the curve in terms of innovation and adaptability in the rapidly changing landscape of mobility and digitalization?'
  While concluding an interview, researchers can assess an OEM's forward-thinking approach and responsiveness to market dynamics by asking about their plans for innovating and differentiating vehicle subscription models. The OEM's innovative and adaptive strategies can be learned from the response, which also reveals the OEM's dedication to meeting changing customer preferences and capitalizing on new mobility and digital transformation trends. By studying the OEM's competitiveness, agility, and future readiness, researchers can learn important lessons that will help them navigate the ever-changing automotive landscape and stay ahead of the competition. Researchers can use this data to learn about the OEM's long-term viability in the automotive sector, innovation priorities, and strategic direction.

  'What emerging technologies or advancements do you foresee shaping the future of data monetization models in the automotive industry, and is your company preparing to capitalize on these opportunities? What are your predictions for the future of vehicle ownership and data utilization in the automotive industry, and is your company positioning itself to remain a leader in this evolving ecosystem?'
  Towards the end of the interview, researchers can assess an OEM's strategic foresight and eagerness for industry changes by asking them about emerging technologies and expectations for data monetization and vehicle ownership. The OEM's knowledge of how technology is influencing data monetization models and their proactive approach to seizing these opportunities can be inferred from the response. The OEM's future plans for vehicle ownership and data utilization can also be revealed by the response, offering insights into their positioning as a leader in the changing automotive ecosystem. Researchers can learn from this data about the OEM's innovation strategies, market projections, and preparedness for navigating upcoming opportunities and challenges in the automotive sector.

The insights obtained from the interviews provided comprehensive and nuanced viewpoints on important components of vehicle subscription and data monetization models, which helped to support the findings drawn from our surveys. These thorough answers gave us a better grasp of the challenges and realities at play, validating the information from our survey and revealing important details that surveys by themselves were unable to reveal. The authorwere able to provide a more thorough and comprehensive analysis of the present and future state of these innovative BMs in the automotive

industry because of this comprehensive approach. The insights from surveys and interviews will be presented in the thesis's following section, which aims to paint a picture of the automotive sector.

6. Survey and interview insights: Stakeholder perceptions of automated and shared mobility

The evaluation and presentation of the results from the surveys and interviews that were conducted are the main objectives of this section. For a thorough understanding of the three stakeholders that we, as researchers, are considering, a business model canvas was created. The business model canvas can help explore all areas for stakeholders, including their tasks, costs, revenue streams, and customer base, providing a comprehensive overview of each stakeholder's business dynamics and strategies. Fig.30, 31, and 32 show a business model canvas for OEMs, PTPs and SMCs (self-depicted).

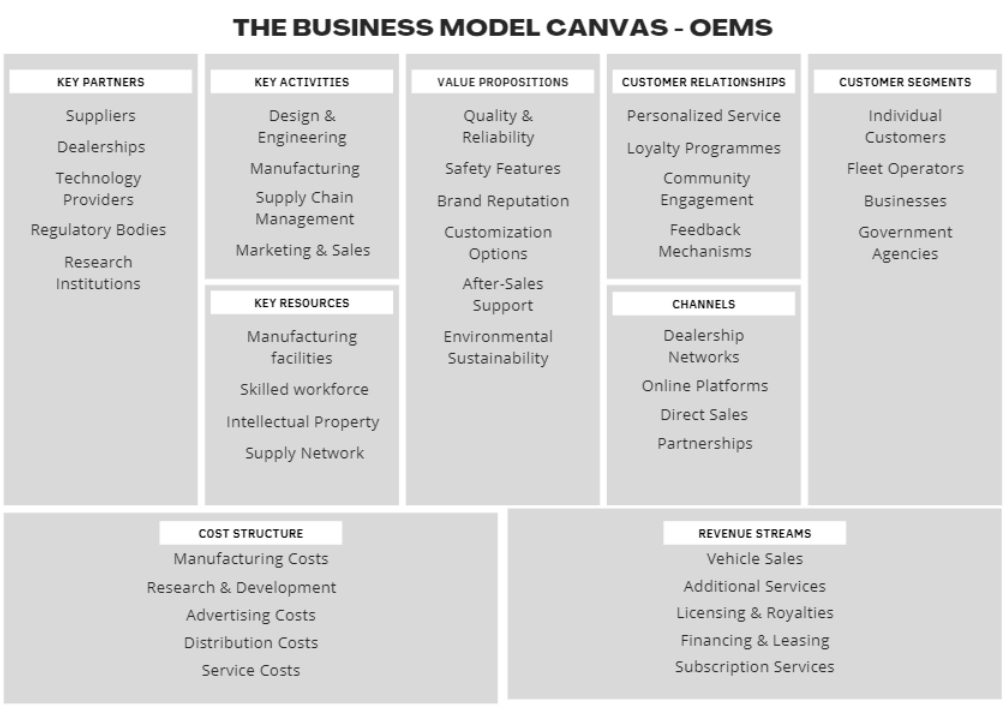


Fig. 30. Business Model Canvas - OEMs

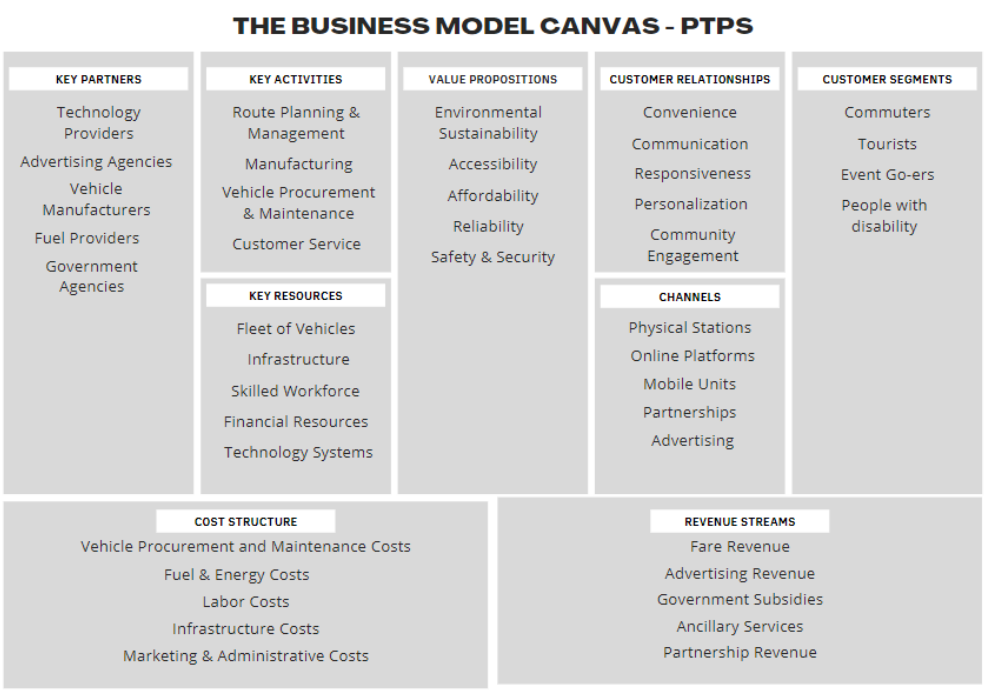


Fig. 31. Business Model Canvas - PTPs

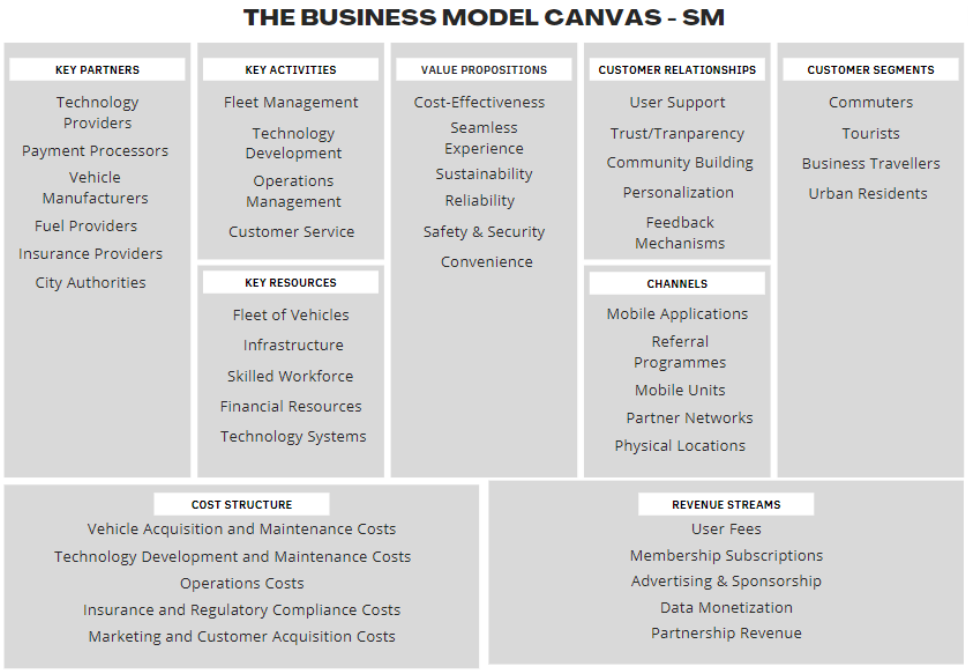


Fig. 32. Business Model Canvas - SMCs

The findings are divided into four sections, each of which answers a research question that was previously mentioned in the thesis. The main goal is to provide readers with perspectives from professionals in business who deal with these issues on a regular basis. Furthermore, the section attempts to clarify the perspectives of different stakeholders regarding broad topics like mobility, both shared and autonomous, MaaS, and so forth. Regarding these themes, it clarifies the various advantages, disadvantages, opportunities, and threats that various stakeholders must contend with.

6.1 Evaluation of the findings – RQ 1

RQ1 focused on understanding how stakeholders perceive the integration of autonomous driving technologies and shared mobility services in both the current and future landscape. It also aimed to identify the factors influencing their attitudes and acceptance of these advancements. Regarding the implementation of AVs in their business, with ease of usage as the primary consideration, 4 out of 10 responding OEMs were very positive, believing that AVs will be easy to use. In contrast, 6 OEMs disagreed, indicating that they believe understanding and using AVs will not be straightforward. Fig.33 shows how OEMs reacted to AVs and their ease of use.

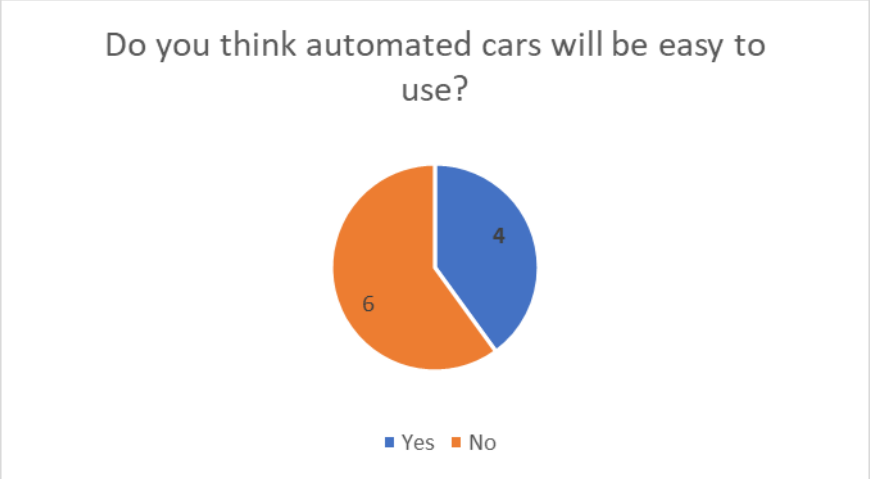


Fig. 33. OEM perspective on AVs and their ease of usage

When asked what factors would encourage OEMs to manufacture and sell AVs, 5 out of 10 OEMs said that "technology readiness" would be a major consideration. As per these OEMs, technology readiness, as it relates to AVs, is the state of development and dependability of the underlying technologies that allow for safe, sophisticated, and effective autonomous driving, such as sensors, AI algorithms, and V2X communication systems. Three OEMs emphasized other important factors, while one OEM declined to comment, and another stated they are still working through this issue. An OEM placed emphasis on "regulatory improvements", which entail the creation and execution of clear and favourable governmental policies and guidelines that expedite the deployment of autonomous vehicles. In order to speed up innovation and prepare for the market, another OEM emphasized the value of "collaborations and partnerships", highlighting strategic alliances with suppliers, other stakeholders, and technology companies. The last OEM placed a strong emphasis on "safety", emphasizing how important it is to make sure AVs can operate without putting passengers, pedestrians, or other road users in danger in order to foster public acceptance and trust. Fig. 34 shows the key factors in the acceptance of AVs, as perceived by OEMs.

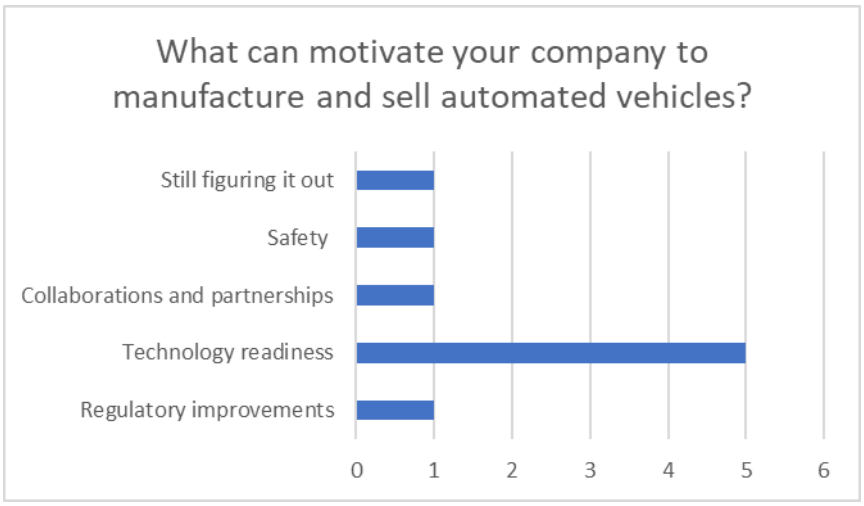


Fig. 34. Key aspects in the acceptance of AVs – OEM perspective

On the other hand, regarding factors that will prevent OEMs from manufacturing and selling AVs, 3 of 10 OEMs cited "regulatory issues" as a major hurdle, and three more OEMs listed "market trends" in addition to "regulatory issues" as factors that could hinder AV adoption. For OEMs, the government's AV regulations are still ambiguous and subject to change. Furthermore, markets and consumers frequently view AVs as future technologies that are not yet prepared for widespread use. Two OEMs considered "technology failure" to be a major risk factor; the other two OEMs highlighted "safety issues" and "customer acceptance" as possible obstacles to the adoption of AV. AV technology is inherently risky due to the complexities of ensuring reliable performance under all conditions. Moreover, the customer mindset still prefers the human element in driving a car, and significant safety concerns persist, making it challenging to gain widespread acceptance and trust in AVs. Fig. 35 shows the factors that might hinder OEMs from manufacturing and selling AVs.

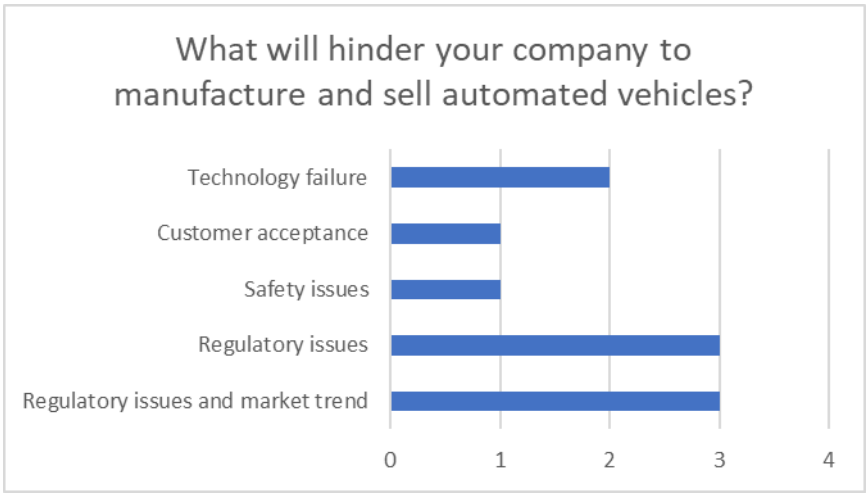


Fig. 35. Potential hurdles in accepting AVs - OEM perception

Additionally, OEMs must comprehend the mindsets and preferences of their customers when it comes to buying a vehicle. The responses to a question regarding the price range that consumers would prefer

for self-driving cars showed some interesting patterns. The majority of OEMs—7 out of 10—agreed that AVs should be priced between 10% and 20% more than traditional vehicles. This suggests that the OEMs think their average customer base would be willing to pay an additional 10-20% for an AV. However, two OEMs stated that given the intricacy and cutting-edge technology involved in creating AVs, the cost would need to be more than 40%. According to the final OEM, a price that is 30–40% more than typical vehicle prices is preferred. These insights align with our literature review, which found that price is a crucial differentiator in the automotive industry. This idea is supported by the majority of OEMs' agreement that consumers would be willing to spend an extra 10–20% on AVs, underscoring the perceived value and readiness to invest in innovative vehicle technologies. Fig. 36 gives us the complete pricing insights for comparing AVs and traditional vehicles, as perceived by OEMs.

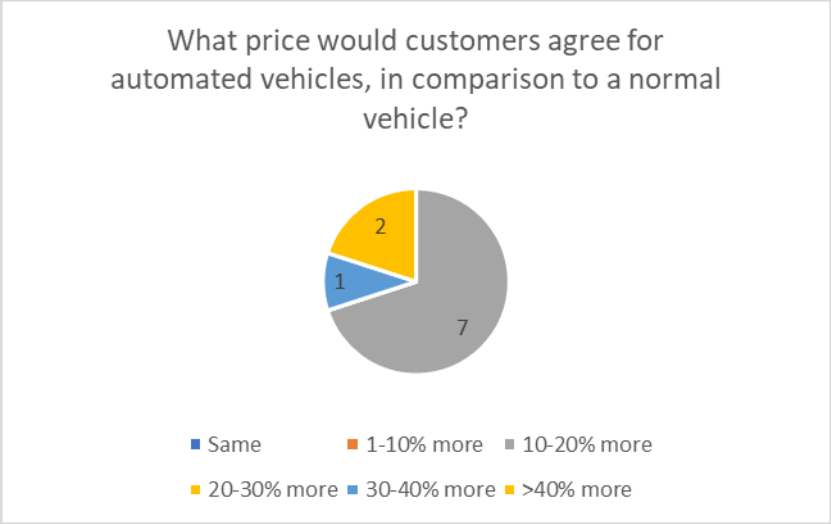


Fig. 36. Pricing insights for AVs - OEM perspective

Continuing, the author sought to learn more about PTP perceptions of AVs and their degrees of acceptance of AVs use in public transportation. The author also investigated how at ease they felt utilizing AVs. 5 of the 6 PTP participants had favourable opinions about AVs and concurred that they would be simple to use. A negative response from a PTP, however, suggested worries about the usability of AVs. According to PTPs, the public transportation sector must be at the forefront of implementing new technologies to stay relevant and competitive. PTPs can secure their place in the changing mobility landscape by adopting AVs, which have the potential to improve efficiency, safety, and the passenger experience. Fig. 37 shows us PTP perspectives on AVs and if they will be easy to use.

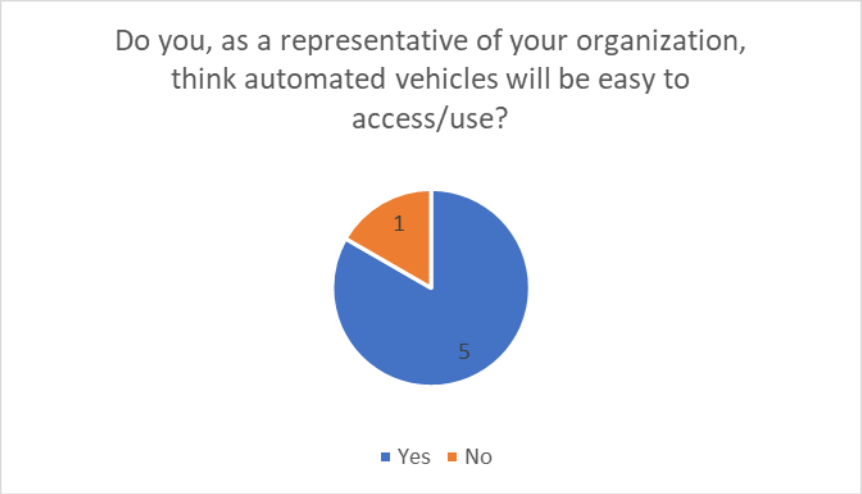


Fig. 37. PTP perspective on AVs and their ease of use

The answers to the question of whether PTPs would be willing to include AVs in their services were not very encouraging. 2 out of 6 PTPs answered "Maybe," expressing ambiguous feelings about AVs. This implies that these PTPs still have reservations and perceive AVs as a far-off possibility. Although two more PTPs said that their company would think about using AVs, this statement implies that there is still no concrete plan to do so. Only one PTP indicated that their organization would use AVs, and another indicated that their organization would definitely incorporate AVs in their services, despite the excitement surrounding AVs and the potential advantages of driverless technology. Fig. 38 shows how willing PTPs are on the topic of incorporating AVs in public tansport.

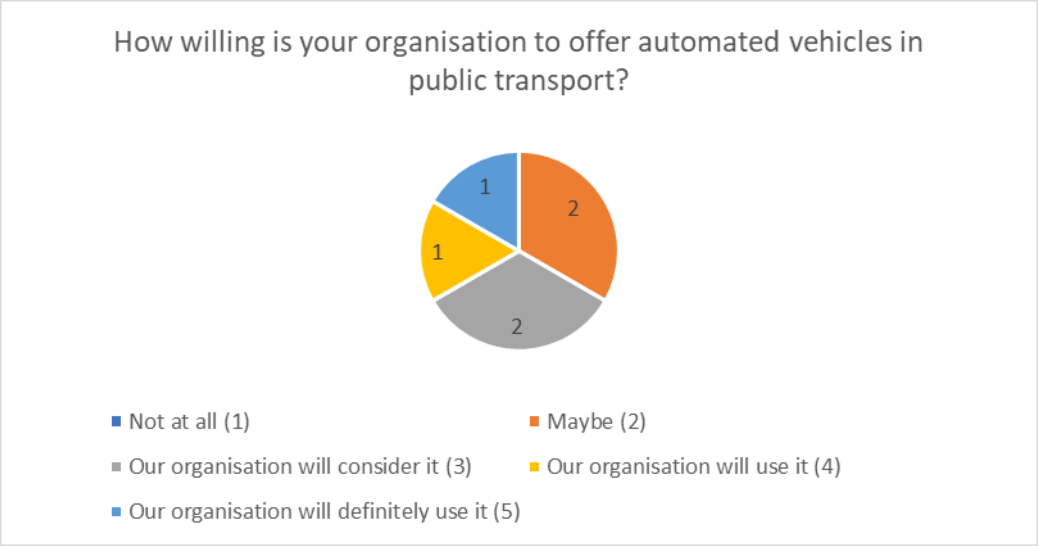


Fig. 38. Willingness to incorporate AVs - PTP perspective

Following our evaluation of PTP acceptance of AVs, the author turn our focus to the key factors that could encourage PTPs to incorporate AVs into public transportation. The author used a ranking method to ascertain the factors that PTPs value most highly. Ranking 1 signifies the most significance, while ranking 6 represents the least significance. PTPs rank "Safety factor of automated vehicles" and "Costs" as the two most important factors, as can be seen in the graph below. The ranking can be seen on the top of the bar graph. According to PTPs, safety is of highest priority in order to protect passengers and reduce accidents, but costs are also important in order to budget and keep services affordable for both

operators and users. When assessing the viability and application of AVs in public transportation services, these variables are crucial. Fig. 39 shows decisive factors for PTPs, when incorporating AVs in public transport.

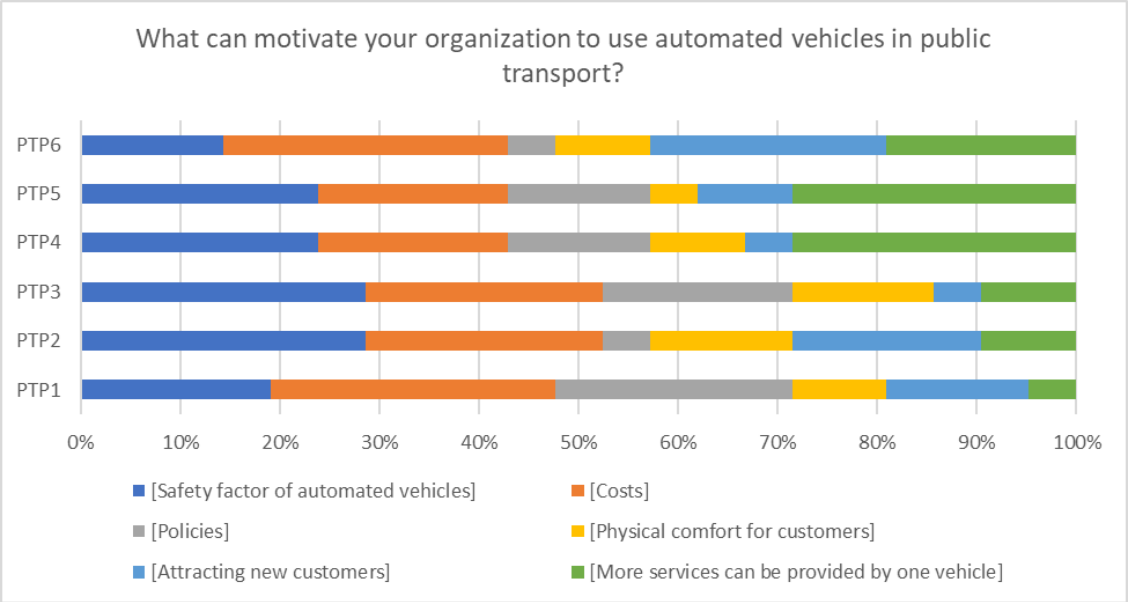


Fig. 39. Key elements that could motivate PTPs to incorporate AVs

These elements might, however, also make it more challenging for PTPs to incorporate AVs into their offerings. The following graph illustrates the barriers that would prevent PTPs from implementing AVs in their businesses. It is clear that "Safety factor of automated vehicles" and "Costs" continue to be the most significant and deciding factors when using a similar ranking method, where rank 1 indicates the most important factors preventing the use of AVs and rank 5 indicates the least important. These factors are crucial in the decision not to incorporate AVs, as safety concerns can deter PTPs due to potential risks and liability issues, and high costs may be prohibitive for public transport operators with limited budgets. Fig. 40 shows decisive factors that might prevent PTPs from incorporating AVs.

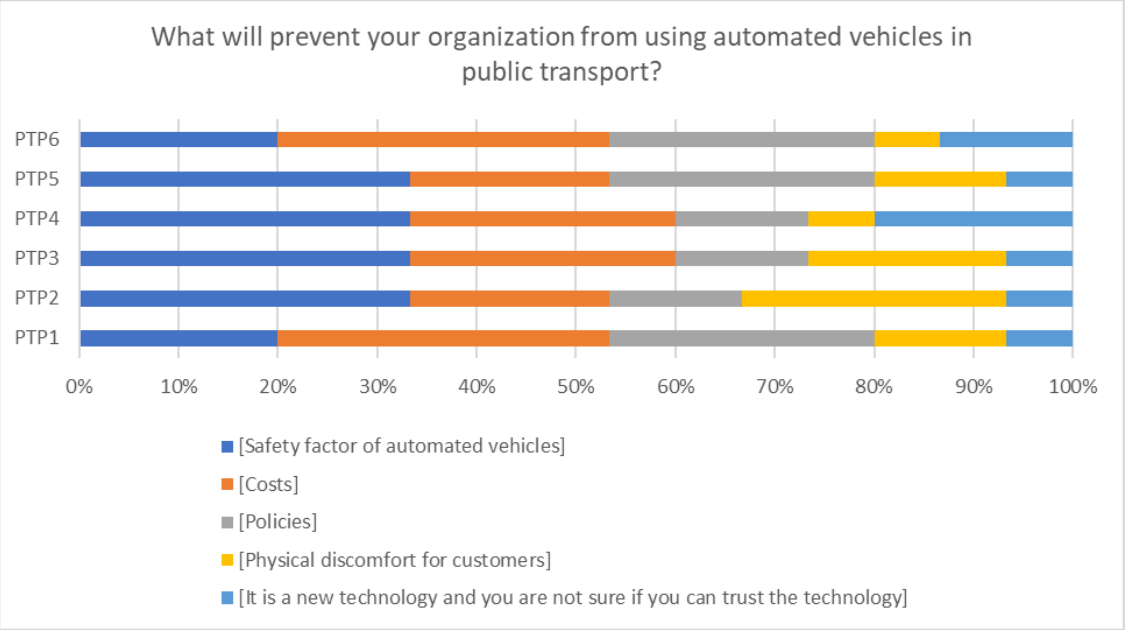


Fig. 40. Potential hurdles in accepting AVs - PTP perspective

AV integration into public transportation will be a lengthy process requiring large financial and investment commitments. 2 out of 6 PTPs indicated there would be "no change" in consumer costs for public transportation whether AVs or the current fleet of vehicles were used. As per the PTPs, government support for public transportation services is strong, so implementing new technology won't always increase consumer costs. However, given the newly integrated AVs and the related expenses, two other PTPs believed that customers would have to pay an additional 10% to 20%. The remaining two PTPs believed that prices would increase by 30–40% or more. PTPs will incur higher costs as a result of advanced technology, which will affect ticket prices and other service fees. Fig. 41 gives pricing insights on how AVs could potentially impact public transport costs.

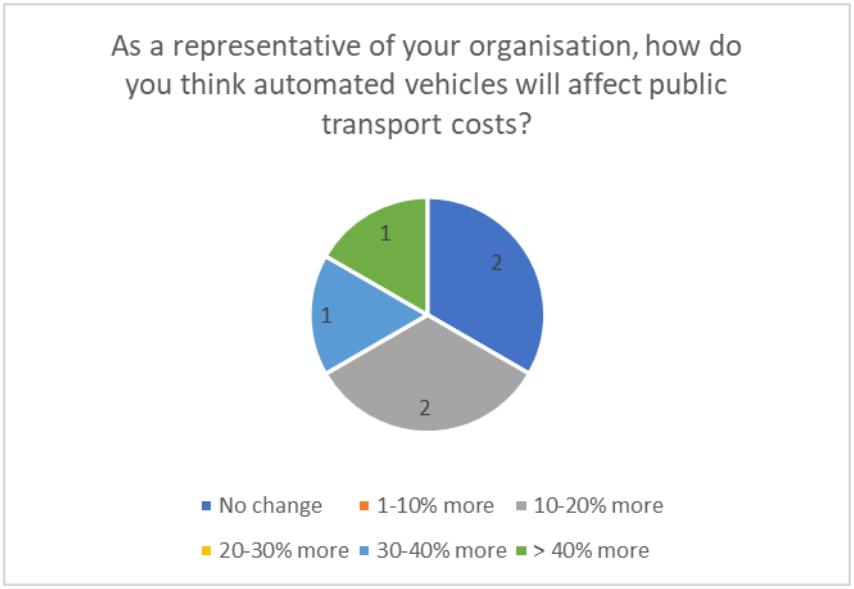


Fig. 41. Pricing insights for AVs - PTP perspective

It's important to know whether PTPs realize the mindsets of their customer base. PTPs gave quite positive responses when asked if they thought customers would accept AVs as a component of public transportation services, even with their complexity and reliability concerns. "Moderate" responses were given by 3 of the 6 PTPs, indicating a moderate level of customer acceptance. One PTP responded favourably, indicating widespread acceptance, and two PTPs responded extraordinarily well, indicating strong customer acceptance. Consumers are generally receptive to new features offered by businesses and willing to embrace modern technologies that companies have to offer. Fig. 42 shows how PTPs perceive their customer willingness to use AVs as a part of public transport.

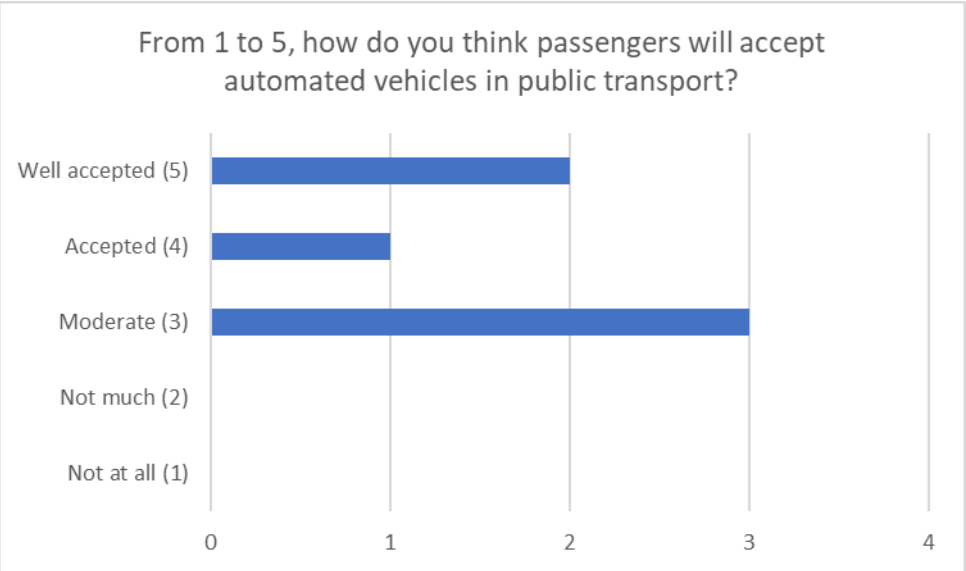


Fig. 42. Customer preferences on AV incorporation - PTP perspective

The author inquired about the opinions of SMC professionals regarding AVs and the ease of use of AV technology. SMCs have a unique perspective because their main responsibilities are different from OEMs', and they concentrate on acquiring and maintaining AVs rather than producing and distributing them. Five out of seven SMCs said that they would think AVs would be easy to use, while two SMCs said that they would not. These answers suggest that the majority of SMCs are persuaded by the AVs' ease of use and that integrating AVs into their strategy may be a part of their future strategy. Fig.43 shows SMCs perspective on AVs and their ease of usage.

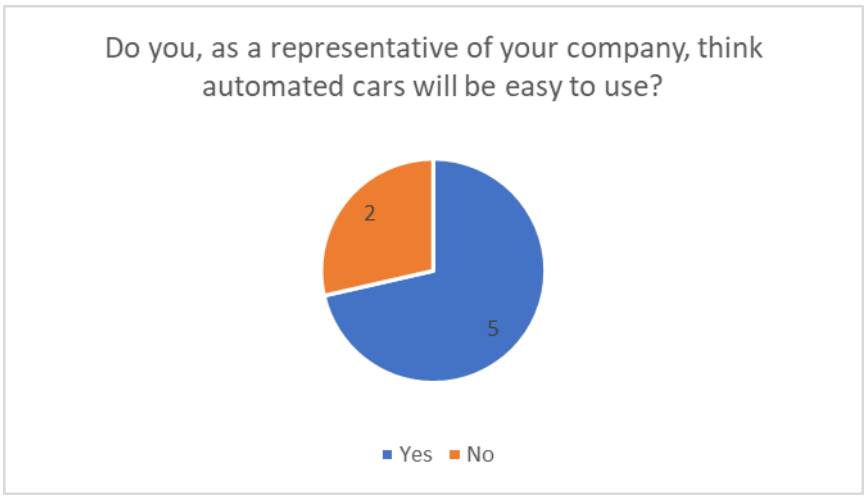


Fig. 43. SMCs perspective on AVs and their ease of use

Using a ranking technique similar to PTPs, the author concentrated on the most important factors that would encourage SMCs to integrate AVs into their businesses. In this case, rank 1 represents the most significant factors influencing the use of AVs, and rank 6 represents the least significant. The information showed that "Safety" and "Costs" were regarded as the primary motivating factors. SMCs would be more likely to incorporate AVs into their fleets and operations if OEMs and tech companies could achieve reasonable costs while guaranteeing vehicle safety. Fig. 44 shows key aspects that would motivate SMCs to incorporate AVs on their fleet.

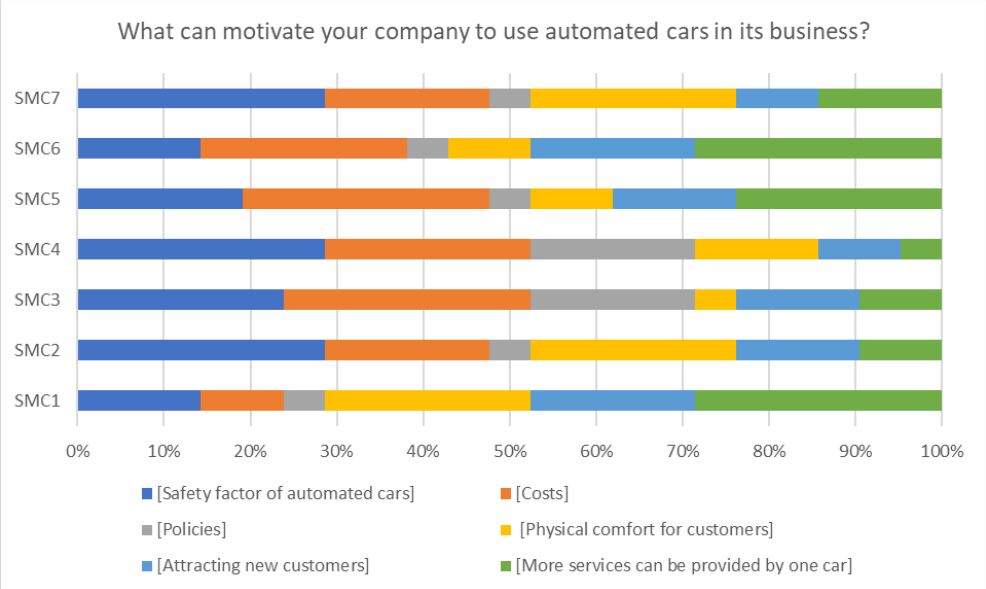


Fig. 44. Key elements that could motivate SMCs to incorporate AVs

However, it will take a significant amount of time and resources to bring AVs up to the required levels of cost and safety. These same concerns about costs and safety were mentioned by SMCs as possible challenges to using AVs in their operations. The author used a similar ranking approach here, where rank 1 signifies the most crucial elements influencing their decision, while rank 6 signifies the least

significant elements. As per our prior discussions, companies should not compromise on these elements since they have an immense impact on their expenses and profit. Maintaining safety is essential to retaining customers and growing the market. Integration of AVs into fleets is hindered by the complexity of AV technology and the high upfront costs incurred by OEMs and technology companies, which would increase SMCs' acquisition costs. Fig. 45 shows the ranking methodology used in understanding the factors that would prevent SMCs from using AVs.

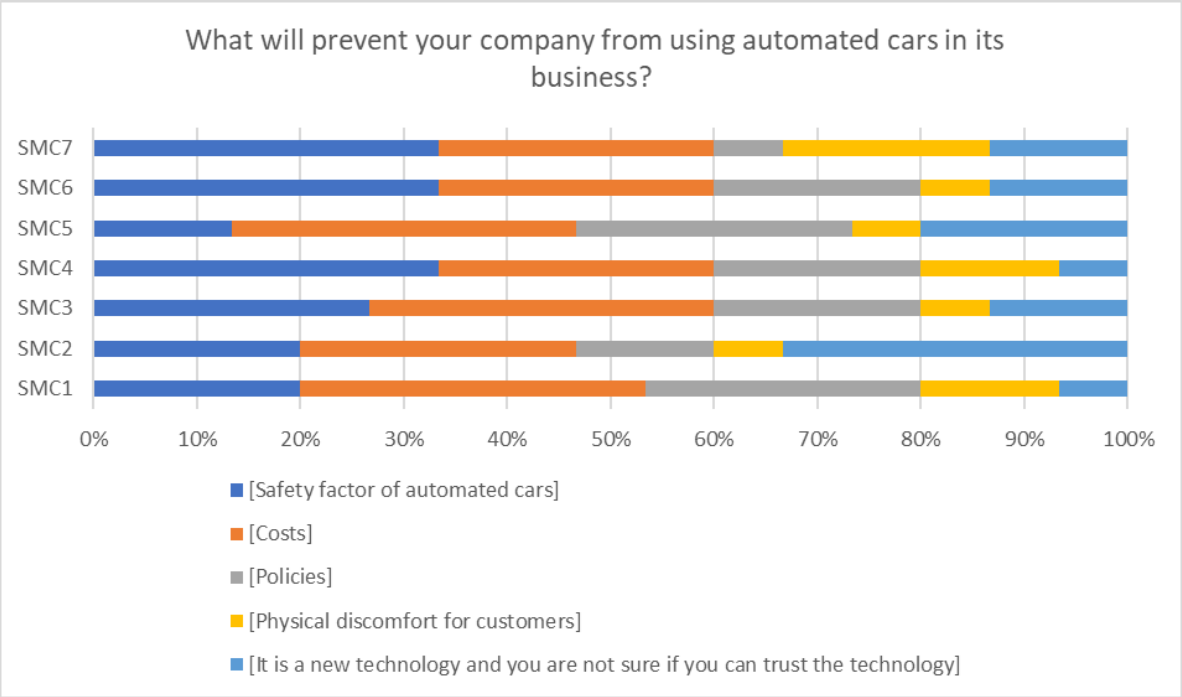


Fig. 45. Potential hurdles in accepting AVs - SMCs perspective

The author sought SMCs' opinions on this matter in order to determine how much they recognized about the potential impact AVs would have on their fleet's servicing costs. SMCs gave a variety of responses, emphasizing different financial consequences. They pointed out that AVs would lower operating costs because of increased safety regulations and lower driver and human costs. This would result in fewer vehicle damages from human error and advanced technology. In addition to reducing damages, this would also save insurance costs. SMCs realized that upfront investments in technology and related areas would be required, but they also thought that these investments would pay off in the long run. Table 2 shows SMCs perspectives on service costs when thinking of AVs.

Company	Opinions
SMC1	Needs further analysis
SMC2	Driver costs will be cut down, but technology costs will add
SMC3	Initial investment required but costs will be reduced later
SMC4	Will reduce as no labour costs to consider.
SMC5	In best case, less damages and so less operational costs
SMC6	Yes, but it's important to carefully analyze the overall impact on service costs as automated cars become more prevalent in the fleet.

SMC7	the costs should decrease, as the safety factor should be higher than with manually operated vehicles. this should result in less damage - so less damage costs and less insurance fee

Table 2. SMC perspectives on AVs affecting service costs of their vehicle fleet

Following the collection of insightful data on automated driving, the author inquired about OEMs, PTPs, and SMCs' inclination to include modern shared services in their range of services. OEMs' responses were significantly distinct from one another. Only one OEM indicated that they would be fully interested in integrating sharing services into their business, while two out of ten OEMs said that their organizations would do so. Two OEMs expressed interest and said they would think about it, but the other two OEMs were strongly against using sharing services. Three OEMs said, "Maybe," expressing their doubts and worries about the difficulties involved in implementing sharing services into their portfolio. Fig. 46 shows OEMs willingness towards shared services.

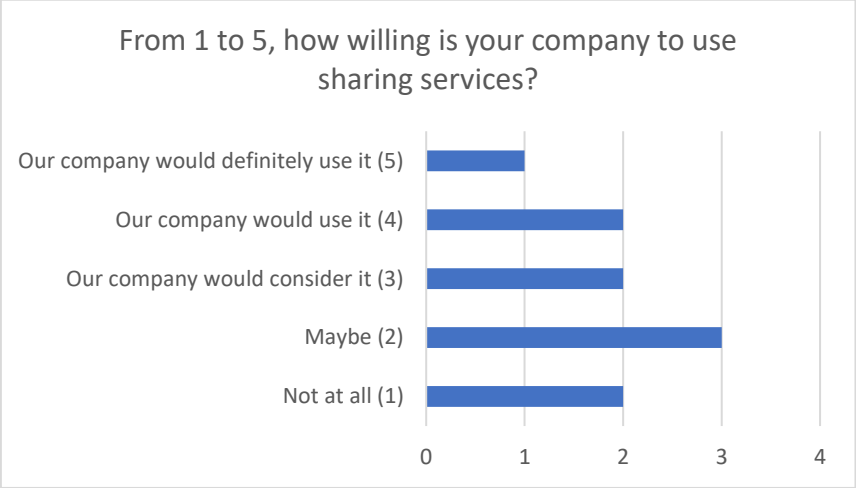


Fig. 46. Willingness to use shared services - OEM perspective

The author also obtained insights from OEMs about the cost-consciousness and readiness of their customers to pay for shared services. The varying answers show that OEMs are still uncertain of the pricing approaches they should take for shared services. Their main business strategy, which concentrates on selling vehicles rather than providing shared mobility solutions, is probably the cause of this uncertainty. If the costs of shared services were 40% lower than those of traditional ownership, according to 3 out of 10 OEMs, customers would be satisfied. Because owning a car involves recurring costs such as insurance, maintenance, and repairs, three more OEMs reasoned that customers would accept shared services at an overall similar cost to that of owning a vehicle. Customers using shared services may take benefit of customized packages that take care of all these expenses—transport, insurance, and maintenance—without having to deal with ownership complications. According to two OEMs, customers would be willing to pay 20–30% less for shared services, whereas the other OEMs recommended that customers would prefer to pay 10–20% or 30–40% less. To find out if shared services will be accepted in the future, especially in terms of cost, more research is still required. Fig. 47 shows OEMs pricing insights on sharing services.

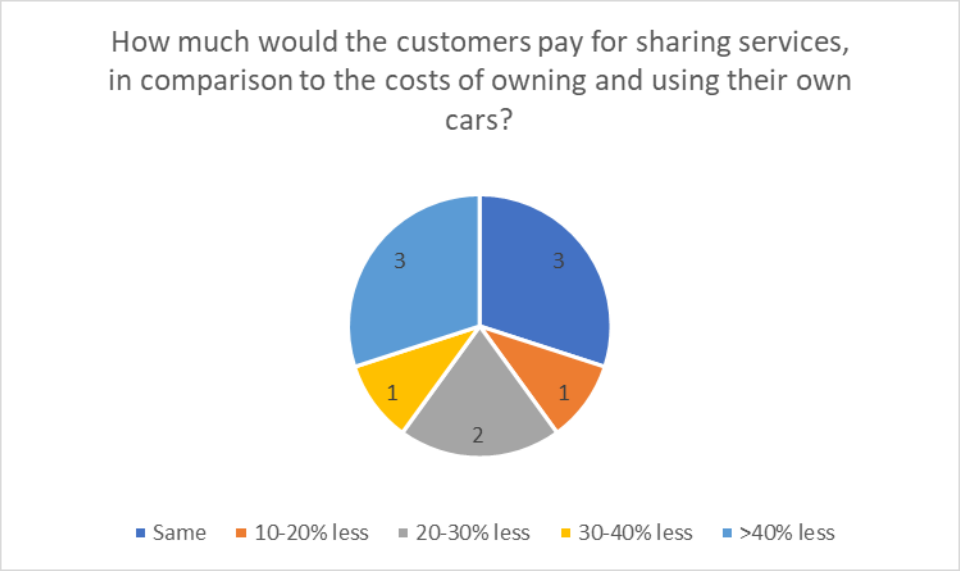


Fig. 47. Pricing insights for shared services - OEM perspective

PTPs provided a clear response when asked how sharing services will contribute to public transportation: first/last mile solutions. Additionally, they emphasized how sharing services would increase opportunities and make living without a car more practical, giving consumers a cost-effective option. The first and last mile—the distance a passenger travels from their starting point to the closest transit hub and from there to their final destination—are the two problems that first/last mile solutions seek to solve. By providing smooth connectivity and decreasing the need for private vehicles for quick trips, these solutions improve the accessibility and convenience of public transportation and encourage more people to use it. As a result, there may be an increase in users, less traffic, and more sustainable urban mobility. Table 3 shows PTPs perspective on sharing services in public transport.

Company	Opinion
PTP1	N/A
PTP2	Expands the opportunities for regular users of public transport to undertake trips without using a personal car and being able to reduce the number of cars owned
PTP3	In the first and last mile
PTP4	good system for first/last mile
PTP5	The already are and provide a cost-efficient provision of pt in specific areas-
PTP6	They make life without private car possible

Table 3. PTP perspective on sharing services in public transport

PTPs also shared their perspectives on the level of willingness to include shared services in public transportation, especially in the context of first/last mile options. Transportation options that link passengers from their starting point to a point of transit and from that location to their final destination are referred to as first/last mile solutions. While one PTP said they would take this option into consideration, 5 out of 6 PTPs firmly agreed that they would integrate shared services into public transportation. Companies can gain a great deal from the integration of shared services into public transportation by increasing passenger convenience, decreasing traffic, and improving overall

accessibility, which will ultimately increase customer satisfaction and loyalty. Fig. 48 shows PTPs willingness on using sharing services (as first/last mile solutions) in public transport.

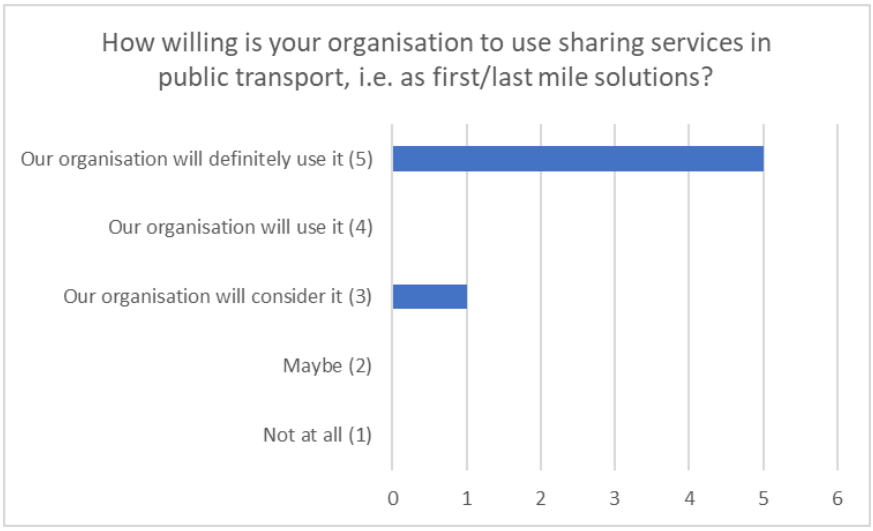


Fig. 48. Willingness to use shared services - PTP perspective

6.2 Evaluation of the findings – RQ2

Understanding industry views on MaaS and the possible opportunities and challenges they see across the whole MaaS ecosystem—including procedures, technologies, methods of implementation, and maintenance—is the main goal of RQ2. The first question was designed to determine how well-versed OEMs have been about the markets and opportunities that MaaS can serve. The majority of OEMs stated that "Partnerships and ecosystem expansion" represent the largest potential that MaaS offers. Both "global market expansion" and "new revenue streams" were emphasized as important opportunities. These MaaS features are essential because they let OEMs increase revenue, grow their customer base, and create an influential ecosystem. The chart below shows additional opportunities and goals that OEMs believe are attainable. Fig.49 shows MaaS opportunities and targets, as per OEMs.

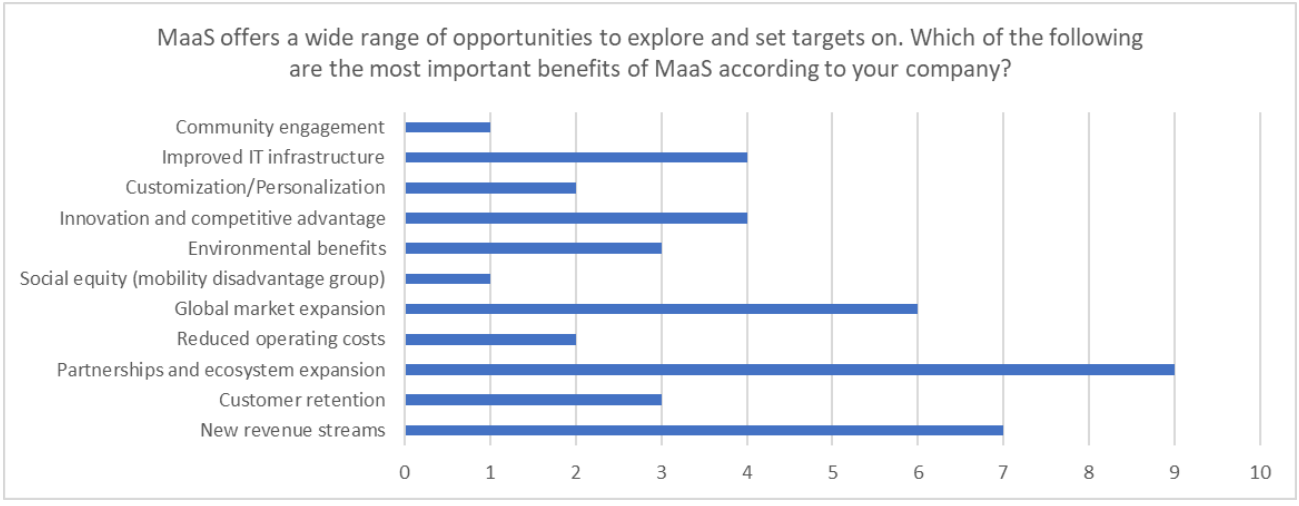


Fig. 49. MaaS opportunities and targets - OEM perspective

However, MaaS also has numerous challenges to overcome before it can be fully integrated into the automotive ecosystem. Of these difficulties, the majority of OEMs considered "pricing strategies" to be the most significant barrier. For OEMs investigating MaaS strategies, effective pricing strategies are critical since they have a direct impact on market adoption and profitability. Other major barriers included "technology dependence," "IT infrastructure investment," and "data privacy and security." Reliance on technology can reduce adaptability and flexibility; investing in IT infrastructure necessitates large sums of money; and protecting customer privacy and security is essential to regulatory compliance and customer trust. Additional factors that OEMs have identified as potential barriers are shown in Fig. 50.

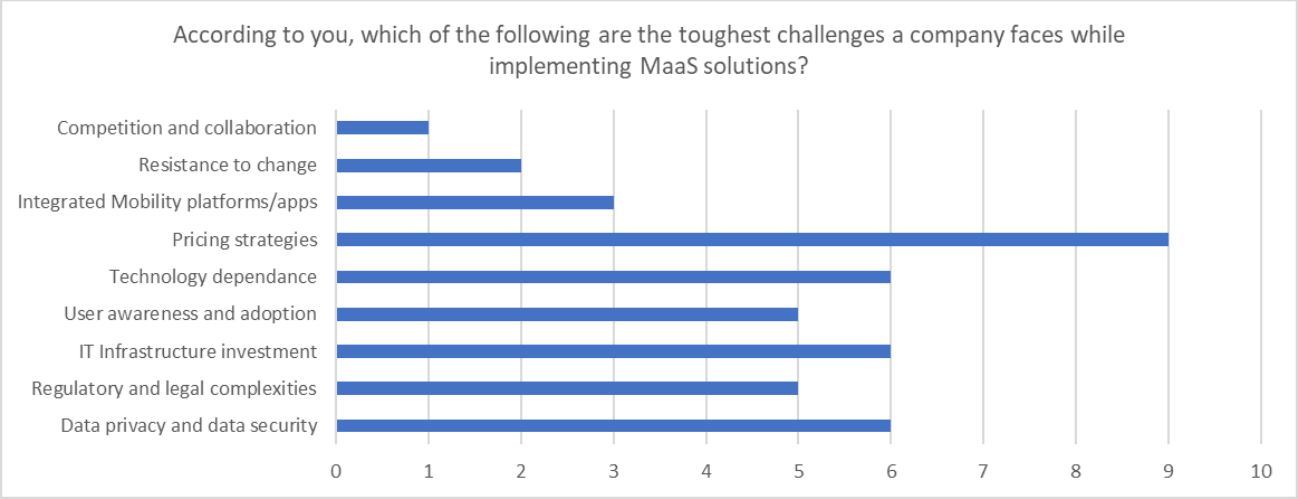


Fig. 50. Challenges in implementing MaaS - OEM perspective

In the same manner, PTPs and SMCs offered insightful information about the prospects and opportunities they perceive in MaaS. The majority of PTPs identified "Partnerships and ecosystem expansion" as the most significant opportunity, as it allows for collaboration amongst different stakeholders to improve service offerings and market reach. "Customization/Personalization" enables specialized services to be provided in response to each unique customer's needs, increasing satisfaction. While "Increased ridership" increases usage and revenue through more enticing services, "Optimized services and improved user experience" ease operations and improve the traveller experience. Next in line, PTPs also thought of other significant opportunities such as "Community engagement" cultivate stronger relations and confidence with the local population, "Improved IT infrastructure" promotes cutting-edge technological capabilities and service dependability, "Customer retention and loyalty" guarantee support and a favourable brand image, and "New revenue streams" present avenues for financial growth through innovative service models and offers. Fig. 51 shows a PTP perspective on MaaS opportunities and targets.

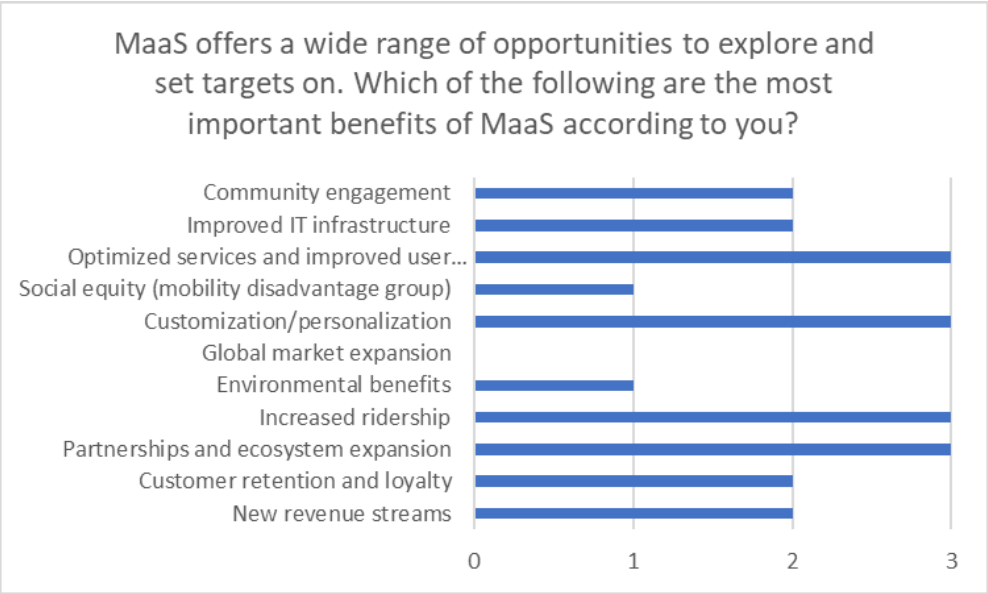


Fig. 51. MaaS opportunities and targets - PTP perspective

SMCs listed three major MaaS opportunities: "Diversification of services," "Improved customer experience," and "Optimized fleet management." MaaS offers a highly digital experience that is valuable to users as well as operators. Companies can more effectively diversify their services and optimize their fleets by utilizing advanced analytics. Customers gain from user-friendly MaaS applications that are suitable for all age groups. These apps minimize effort and provide incentives, rewards, and other benefits, which improves the user experience in the end. SMCs have identified several noteworthy opportunities, such as "Increased market reach" and "New revenue streams." These highlights demonstrate SMCs' perspective of MaaS as a tool to broaden their market presence, penetrate emerging markets, and investigate additional revenue generation via flexible mobility offerings. Fig. 52 shows SMCs perspective on MaaS opportunities and targets.

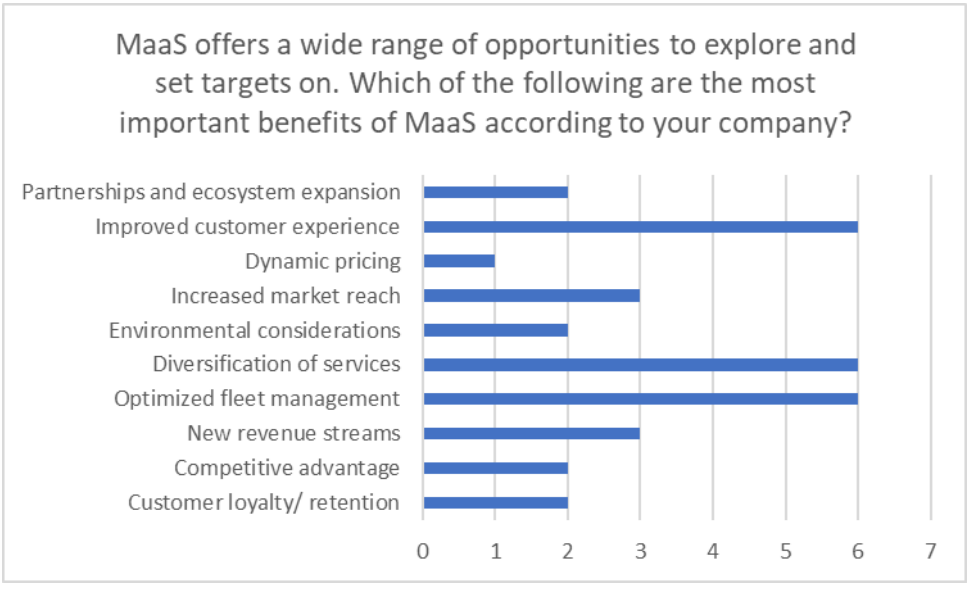


Fig. 52. MaaS opportunities and targets - SMC perspective

PTPs identified "Integration complexity", "Data privacy and security", and "Regulatory and legal complexities" as the three biggest barriers that organizations face when implementing MaaS. Integration complexity is the technical challenge of integrating different systems and technologies to produce a seamless MaaS experience. The need to safeguard sensitive user data, which is essential to preserving user trust, gives rise to data privacy and security concerns. Navigating various laws and regulations across regions is one of the regulatory and legal complexities, and it can be expensive and time-consuming. Another issue suggested by PTPs was that creating "Integrated mobility platforms/applications" might be highly challenging. This means creating user-friendly apps with a variety of features, a smooth digital experience, and less hassle. PTPs also highlighted issues including "Digital infrastructure investments", "Technology dependence", and "Pricing strategies." Managing advanced technologies, setting up competitive yet affordable prices, and making large investments in the digital infrastructure required to support the MaaS ecosystem are some of these challenges PTPs perceive to be influential. Fig. 53 shows the additional challenges and gives an overview of the MaaS barriers as stated by PTPs.

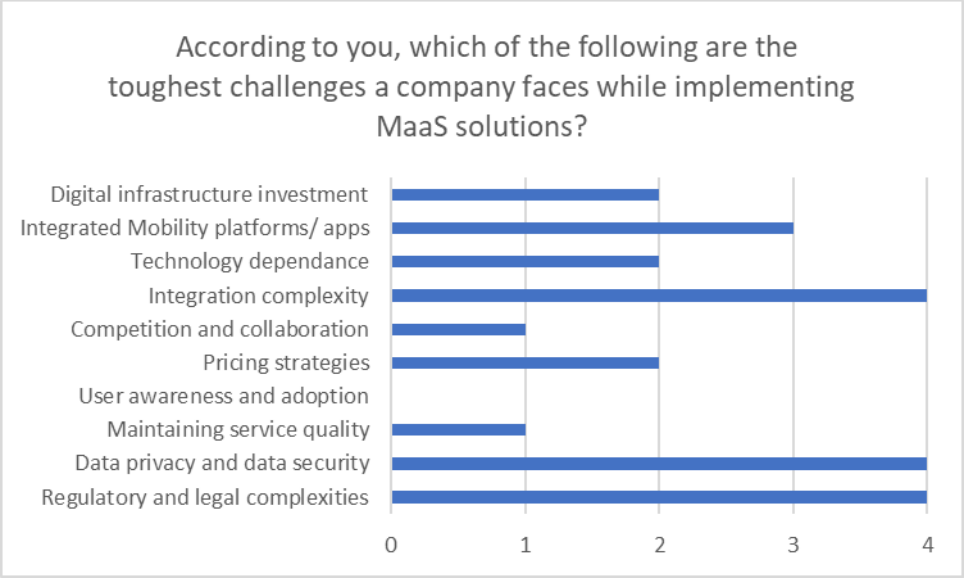


Fig. 53. Challenges in implementing MaaS - PTP perspective

SMCs additionally pointed out a number of challenges that they believe to be the most significant. The main obstacle was identified as "Technical and integration complexities," which was followed by "Technology and IT investments," "Data sharing and collaboration," and "Technology dependence." Compared to OEMs and PTPs, SMCs have a different perspective on MaaS challenges. The integration of necessary technologies is a challenging task that requires significant resources and time for SMCs, especially those that are relatively new and investigating the latest attributes. As many SMCs have pointed out, substantial investments in IT and technology also pose a significant challenge. Collaboration and data sharing were viewed as significant obstacles due to the uncertainty surrounding data privacy laws and issues. Close cooperation with relevant parties is therefore required to guarantee compliance and safe data handling. Fig. 54 shows SMCs challenges and concerns about MaaS.

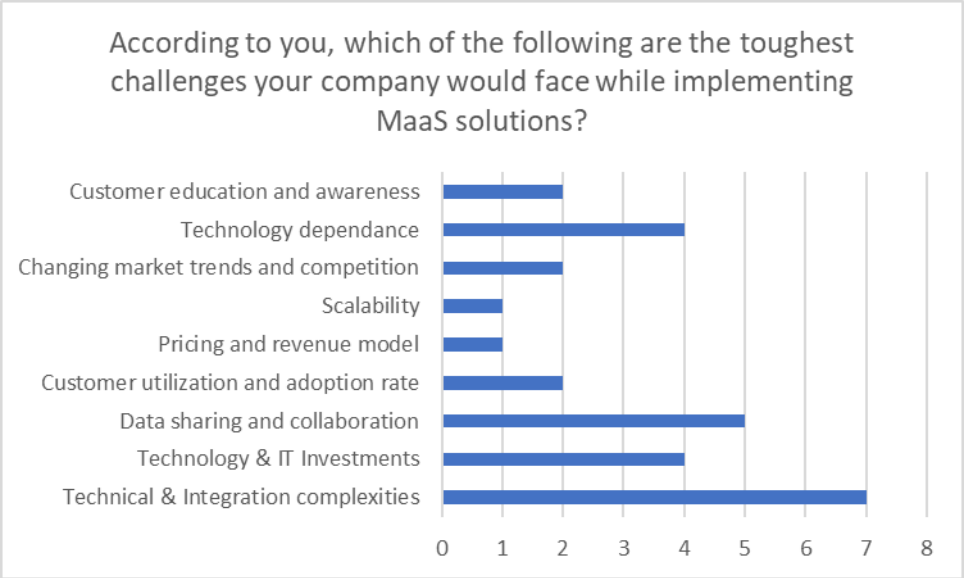


Fig. 54. Challenges in implementing MaaS - SMC perspective

6.3 Evaluation of the findings – RQ 3

RQ3 focuses on vehicle subscription BMs and how they affect customer behaviour and market dynamics strategically. The viewpoints of OEMs, PTPs, and SMCs regarding vehicle subscription models are distinct and encompass various aspects such as the perks they offer, bundling of services, difficulties, and opportunities for collaboration among businesses that may strengthen these models. Insights from the interviews were also mentioned here, as they backed the survey insights and also gave us some deeper information. OEMs gave a range of answers when questioned about how vehicle subscription models might affect their sales and profits. The majority of OEMs highlighted these BMs' potential, especially in terms of generating additional revenue and profitability. The responses from OEMs about how subscription services could affect their companies' sales and revenues are shown in the table below.

Company	Responses
OEM1	High potential with higher margin
OEM2	Very less impact as of now
OEM3	Not a huge impact on revenue
OEM4	Optimal fleet management and additional revenue
OEM5	Not huge due to customer mindset
OEM6	N/A
OEM7	As Positive
OEM8	Secondary income + high utility of cars
OEM9	These are the added revenue models for companies to capitalise on
OEM10	Very important service and demanded by the customers.

Table 4. Potential impact of subscription services on sales and revenue - OEM perspective

When asked which features of subscription services are most important to their customers, with 1 being most important and 5 being least important, OEMs highlighted "Pricing policies" and "Minimum hassle and no long-term commitment" as being of greatest importance. From interviews, we realized that these features, which provide flexibility and cost-effectiveness—two qualities that are highly valued in today's market—align with modern consumer preferences. The customer experience can be greatly enhanced, and loyalty may be strengthened by streamlining the subscription process and offering compelling pricing structures. OEMs also emphasized the importance of "Availability and variety of vehicles" as an additional significant aspect. One industry expert said that a variety of vehicles guarantees that customers have access to a wide variety of cars, making upgrades easier and offering choices for different needs and preferences. A large selection of cars improves the overall subscription experience and adds to customer satisfaction by providing newer models and well-maintained vehicles. Fig. 55 below shows OEMs' perspective on the most important subscription features.

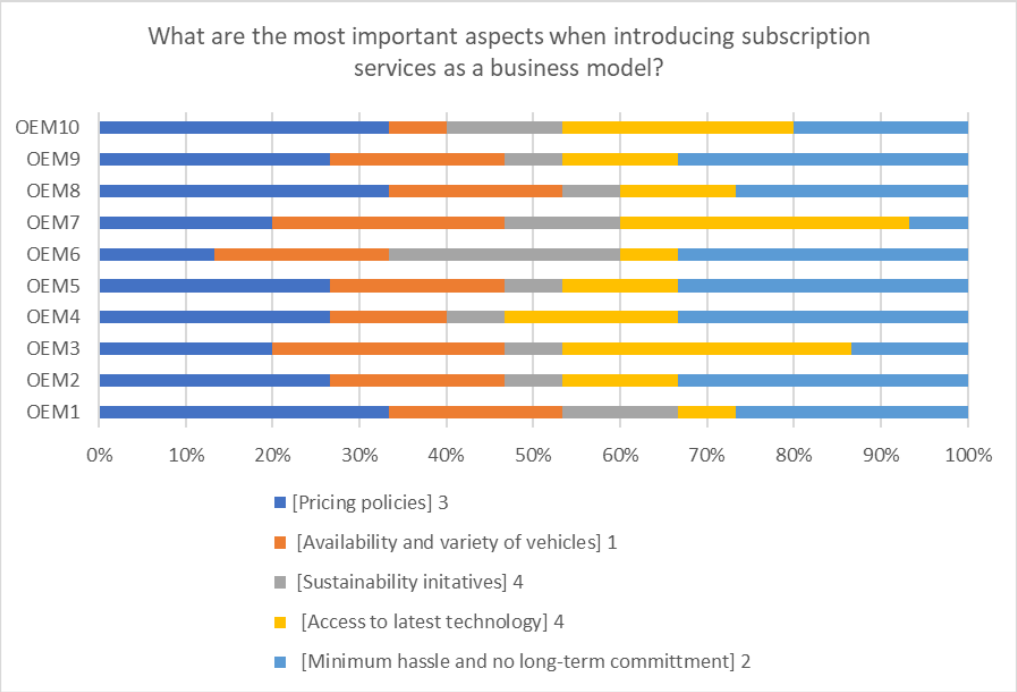


Fig. 55. Most important aspects of subscription services - OEM perspective

OEMs were asked what services and features they would offer to set their vehicle subscription model apart from traditional ownership strategies, with a view on discussing the specifics of the packages and differentiating elements that could make the vehicle subscription model effective and accessible. "Insurance, maintenance, and repair" was mentioned by all OEMs as a critical service to include in a subscription package. Furthermore, OEMs emphasized services like "EV charging services," "membership programs," and "business services" as services that could be bundled together to improve their subscription packages. Through interviews, the author gained a few in-depth insights on the services and features. Access to home charging options, battery maintenance services, and charging networks are a few examples of EV charging services. Membership programs may grant members special privileges, perks, and discounts at partner businesses. Mileage tracking, expense reporting, and other corporate package features are examples of business services. For customers who want hassle-free mobility and zero commitment, a bundled package that includes multiple services

and vehicle usage can be advantageous. The OEM's viewpoint on the services that might be included in vehicle subscription packages is depicted in the Fig. 56.

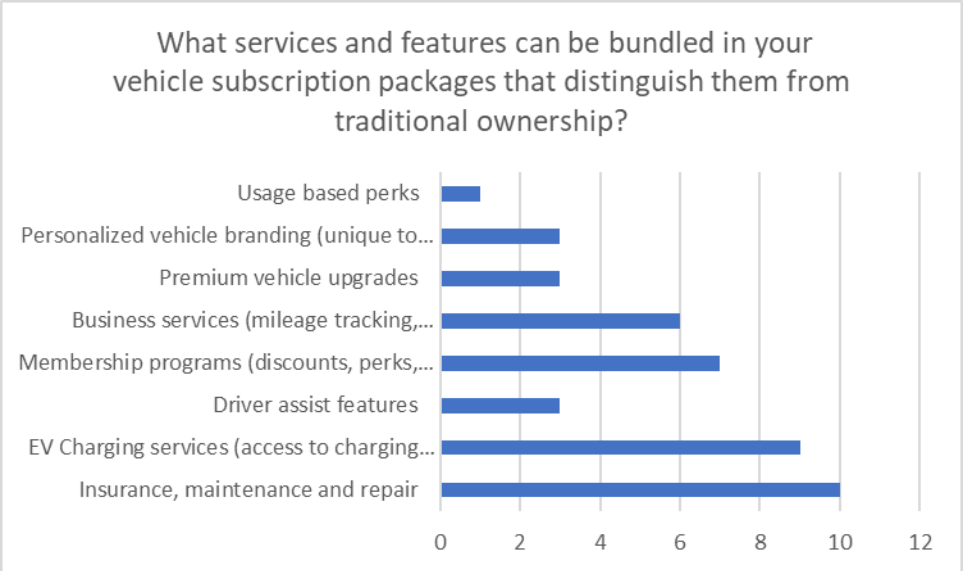


Fig. 56. Service bundling in vehicle subscription - OEM perspective

OEMs cited "infrastructure and technology investments" and "vehicle/inventory utilization rate" as their biggest concerns when asked about the main challenges and fears associated with implementing and sustaining vehicle subscription models in their portfolio. Through interviews, the author got some deep insights on why these factors were considered as major concerns by OEMs. Substantial investments in infrastructure and technology are necessary for vehicle subscription business models in order to track vehicle usage, manage digital platforms, and guarantee ideal customer experiences. Furthermore, the optimal use of their fleet of vehicles is essential to the success of vehicle subscriptions, as underutilized vehicles can result in higher expenses and lower profitability, necessitating effective inventory management. OEMs also mentioned "cultural shift," "pricing and operational complexities," and "product and service flexibility" as significant challenges. Setting competitive yet profitable subscription fees and handling the logistical aspects of vehicle distribution and maintenance are key components of pricing and operational complexity. The need to shift consumer attitudes from traditional ownership to subscription models is referred to as a "cultural shift," and it can be quite difficult as vehicle ownership is often associated with an emotional aspect. In order to satisfy a wide range of customer preferences, product and service flexibility means providing a selection of vehicles and adaptable subscription packages, which calls for a dynamic and flexible approach. Fig. 57 shows the challenges/concerns that OEMs have about vehicle subscription.

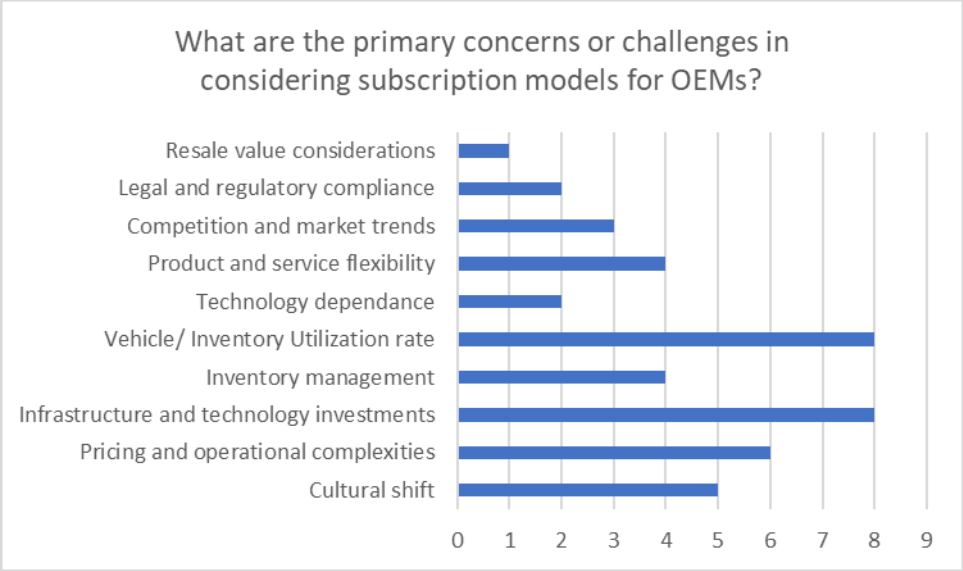


Fig. 57. Challenges/concerns related to vehicle subscription models - OEM perspective

In order to improve vehicle subscription models and enhance urban mobility by merging business methods with technology and data expertise, the author asked OEMs if they saw any potential synergies with tech- and data-based startups. OEMs were mostly in favour of these partnerships and alliances, indicating a desire to strengthen the automotive ecosystem for the mutual gain of each party involved. About these synergies, 6 out of 10 OEMs expressed a "positive" opinion, emphasizing that long-term, cooperative, organizationally driven partnerships are ideal. According to one OEM, things are "slightly positive," meaning that these kinds of synergies can only emerge with the necessary skills and knowledge. One OEM declined to comment, but two were "very positive," seeing these synergies as the only way forward. Table 2. shows the responses shared by OEMs. Table 5 shows OEM responses on potential synergies with startups.

Company	Opinions	What kind?
OEM1	**Positive**	More organizationally driven
OEM2	**Positive**	Joint ventures and collaborative measures
OEM3	**Positive**	High possibility
OEM4	**Positive**	Long term partnerships
OEM5	**Slightly positive**	Only with required knowledge and expertise
OEM6	**No response**	N/A
OEM7	**Positive**	Can be a solution to be implemented
OEM8	**Positive**	Partnerships for improving digital services
OEM9	**Very positive**	Data based startups provide the technological back bone to traditional automakers
OEM10	**Very positive**	Highly beneficial

Table 5. Potential synergies with startups - OEM perspective

The author also requested that PTPs share the features that they would be interested in adding to their mobility offerings in order to improve customer satisfaction and promote the use of public transportation rather than private vehicles. PTPs gave "Real-time information" and "multimodal integration" top priority, with "personalization" and "enhanced customer support" next. The term

"multimodal integration" describes the smooth integration of different forms of transportation into one cohesive system, including bikes, buses, trains, and ride-sharing services. Digital signage and service schedules that offer the most recent information on transit arrivals, departures, and delays are examples of real-time information. These characteristics are essential because they increase the effectiveness and convenience of public transportation, increasing its user appeal. Offering customized plans, favoured routes, and priority access in accordance with personal preferences is referred to as personalization. Proactive help and quick response channels are examples of enhanced customer support. By promoting customer loyalty and regular public transportation use over private vehicles, these features can greatly enhance the user experience. Significant features that could be a part of mobility offerings in the future, and Fig. 58 shows the PTP perspective on it.

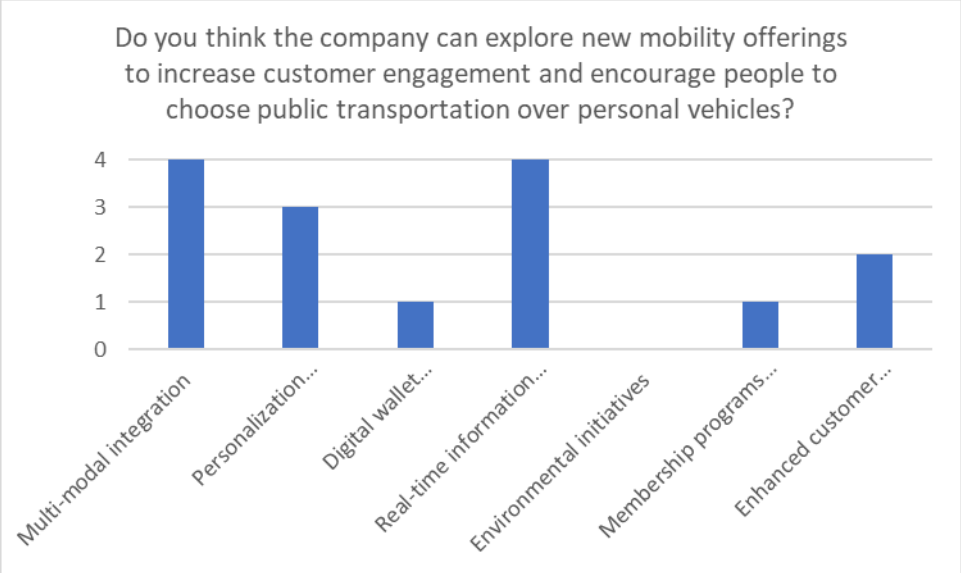


Fig. 58. Important features for mobility offerings in public transport

PTPs additionally touched on risks and challenges that could arise when adding subscription services to their portfolios. "Financial viability or impact on revenue" was the main challenge, according to them. This involves assessing whether the subscription model can bring in sufficient revenue to pay for operating costs and boost profitability, both of which are critical for public transportation providers. To maintain its sustainability over time, transitioning to a subscription model might necessitate significant initial investments and careful planning. PTPs also highlighted "Fleet management and additional investments" as a significant issue. Handling a larger, potentially more differed fleet necessitates higher costs for vehicle acquisition and maintenance as well as complex logistics. Possible challenges such as "IT integration and costs" were also mentioned. Subscription services require a significant investment in hardware, software, and cybersecurity measures, all of which can be complicated and expensive to implement. All of these elements present significant obstacles for PTPs who are considering implementation of subscription-based BMs. Fig. 59 shows the concerns/challenges PTPs have over subscription models.

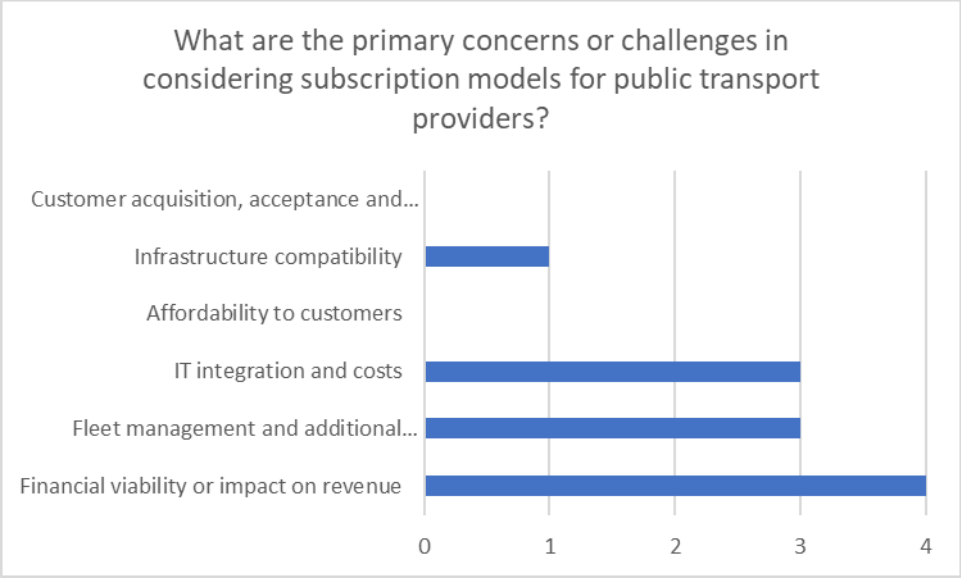


Fig. 59. Challenges/concerns related to vehicle subscription models - PTP perspective

Additionally, SMCs showed interest in vehicle subscription models and gave thoughtful feedback about how they thought these models would affect revenue and sales. The majority of SMCs thought that the company could make additional revenue from subscription services because of their flexibility. One SMC brought up the point that these services would target a group of people that has no interest in owning a vehicle. Another SMC responded that since leasing makes up a small portion of the company's revenue, subscribers may have a similar perception of subscription services, which could have a less impact on overall revenue. Table 6 shows the responses shared by SMCs on the potential impact of subscription services on sales and revenue of the company.

Company	Opinion
SMC1	N/A
SMC2	Similar to car rental - more flexible, can get additional revenue for company
SMC3	Definitely a boost
SMC4	Lease of vehicles is not a large part of our current business so the impact is not high, although if it reduces the TCO of vehicle ownership this would likely reduce usage of our services therefore impacting sales/revenue
SMC5	Important, its part of new mobility offers. Sharing - Rental - Subscription
SMC6	Sales could increase. But this model appeals to a different target group: namely those who do not want to do without their own vehicle.
SMC7	very high

Table 6. Potential impact of subscription services on sales and revenue - SMC perspective

The key aspects of introducing subscription services as a business model were also discussed by SMCs. They determined that "Service selection and customization" and "Fleet management and customer utilization rate" were essential components for the success of subscription models. Effective fleet management guarantees a high rate of vehicle utilization, which implies that users regularly subscribe to the fleet, potentially leading to higher profit margins and revenue growth. Furthermore, in today's dynamic market, the flexibility of subscription packages—which includes service selection, vehicle

choices, and several payment options—is essential for satisfying a wide range of customer preferences and boosting the appeal of subscription services. Fig. 60 shows important aspects of subscription services, according to SMCs

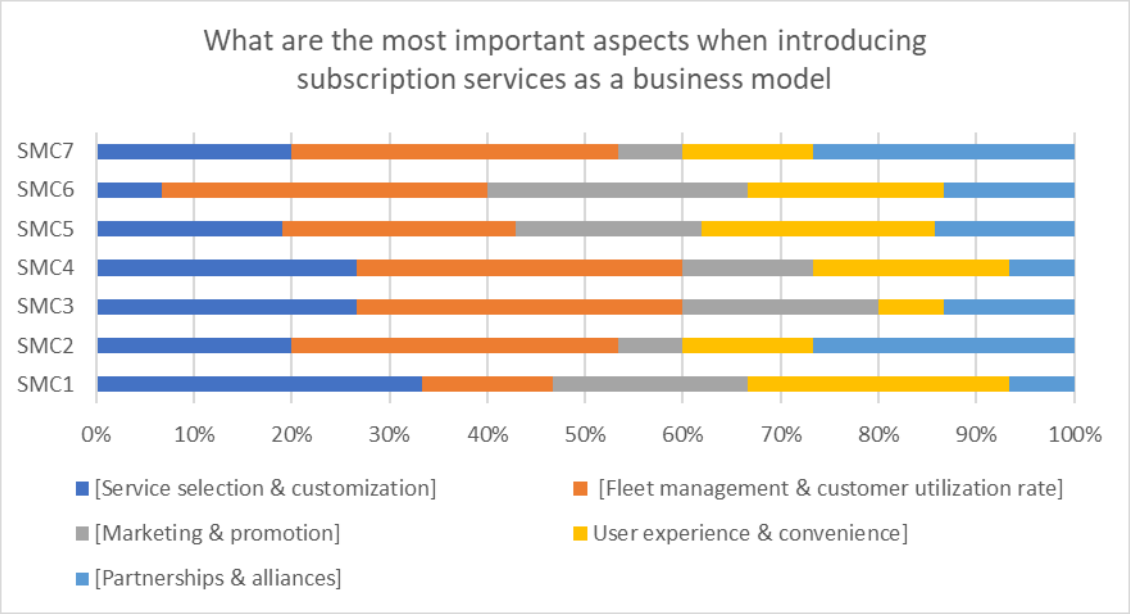


Fig. 60. Most important aspects of subscription services - SMCs perspective

The author asked SMCs for their opinions on which solutions would be essential for the successful adoption and implementation of these services in order to determine if they are aware of the technology and software solutions that could be integrated within subscription services. A mobile app/web platform that is integrated would be the most significant technology/software solution, according to SMCs, for subscription services. This mobility app would offer features like simple access to subscription plans, vehicle availability, payment options, and customer support, making the user experience smooth and convenient. "Fleet management software," that assists in tracking and optimizing the use of the vehicle fleet, ensuring efficient operations and maintenance scheduling, is another vital solution recommended by SMCs. By offering real-time data on vehicle performance and usage, "Telematics and IoT Integration" improves operational efficiency and safety. For seamless handling of customer subscriptions, renewals, and billing procedures, a "Subscription management system" is necessary. By providing consumers with immediate assistance and problem solving, "Customer support and chatbots" elevate customer satisfaction. Last but not least, "Analytics dashboard for customers and operators" enables data-driven decision-making and customized user experiences by enabling both parties to track and examine usage trends, habits, and operational indicators. Fig. 61 shows the important technology and IT solutions that can be developed for subscription services, according to SMCs.

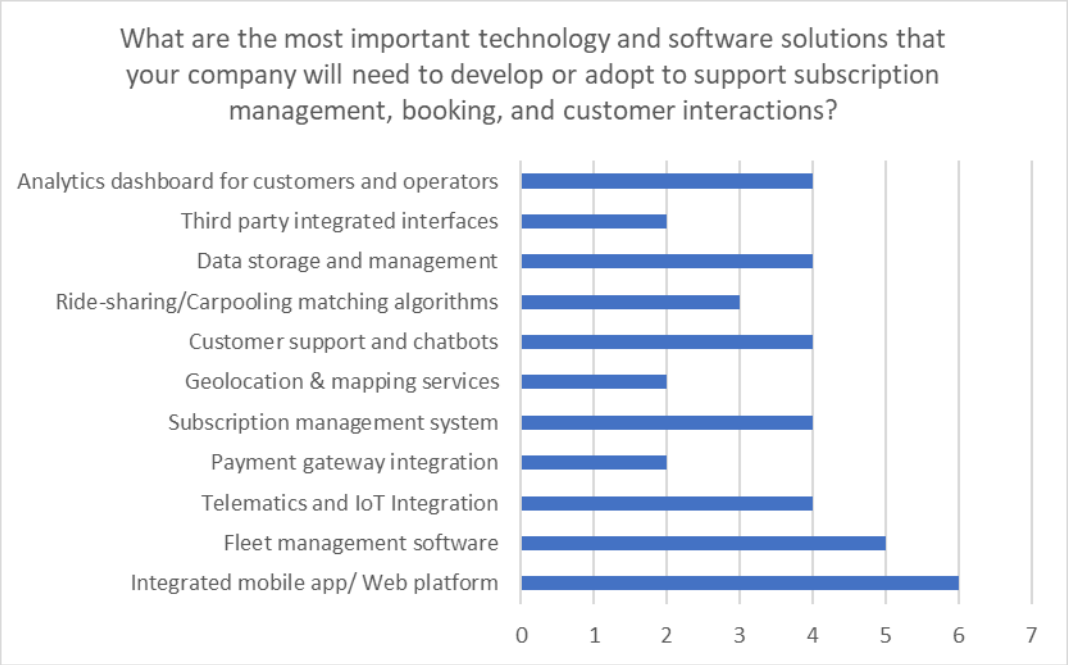


Fig. 61. Important tech and IT solutions for subscription services – SMC

The author questioned SMCs about the worries and concerns they had about subscription services, which could keep them from putting these BMs into practice. SMCs stated that "Pricing & profitability" of subscription services is the biggest concern for them. Since these services are still relatively young, finding competitive yet reasonable prices may prove difficult. Although high margins are the target of subscription services, their success would solely depend on the number of subscribers. "Resource allocation," which involves efficiently handling vehicles, drivers, and staff to meet demand without overextending resources, is one of the other concerns that SMCs identified. "Operational and additional costs" like maintenance, insurance, and repairs could have a big effect on how profitable subscription services are. The problem of "business scalability" arises from the need for significant financial and logistical planning in order to take the service to a wider market. Last but not least, "Customer acquisition and education" is critical since broad adoption and long-term success depend on attracting in and educating consumers about the advantages and applications of subscription services. Other concerns are shown in Fig.62.

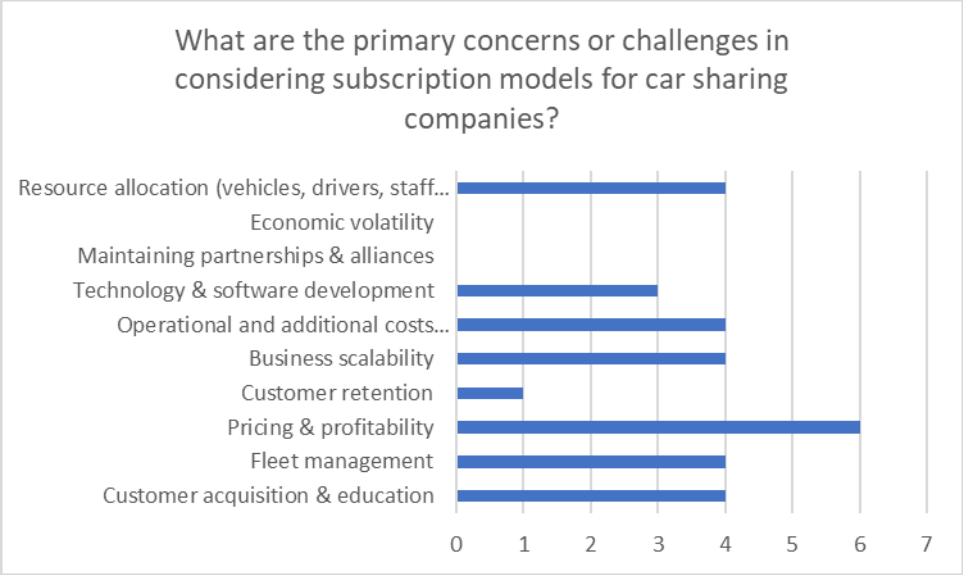


Fig. 62. Challenges/concerns related to vehicle subscription models - SM perspective

The author asked SMCs about factors that would be critical in increasing market penetration and attract customers to sign up for subscription services and other offerings from carsharing, car rental, and carpooling businesses. Several important factors were identified by the respondents, with "flexibility" and "competitive pricing & clear value proposition" being the most significant. Customers can personalize services to meet their needs with the flexibility of subscription plans and add-ons, which offer options like long-term or short-term rentals and customizable features. Subscription services are more appealing when they offer competitive pricing and a clear value proposition, which guarantee that customers view the service as worthwhile and affordable. SMCs also highlighted the importance of keeping a diverse and well-maintained fleet of vehicles. Customers may be attracted in by appealing features like vehicle upgrades, smooth and safe travel, and access to the latest technology, all of which can greatly boost their interest in vehicle subscription services. Additionally, "Good user experience & customer service", "Safety measures", and "Corporate and B2B partnerships" were noted as lesser but still significant factors. Robust safety measures guarantee that customers have confidence in the service, and an optimal user experience combined with outstanding customer service can encourage loyalty and satisfaction. Corporate and B2B partnerships have the potential to increase market penetration and customer involvement by providing businesses with tailored offerings and extending their market reach. Fig. 63 shows SMCs perspective on factors that would increase market penetration for subscription services.

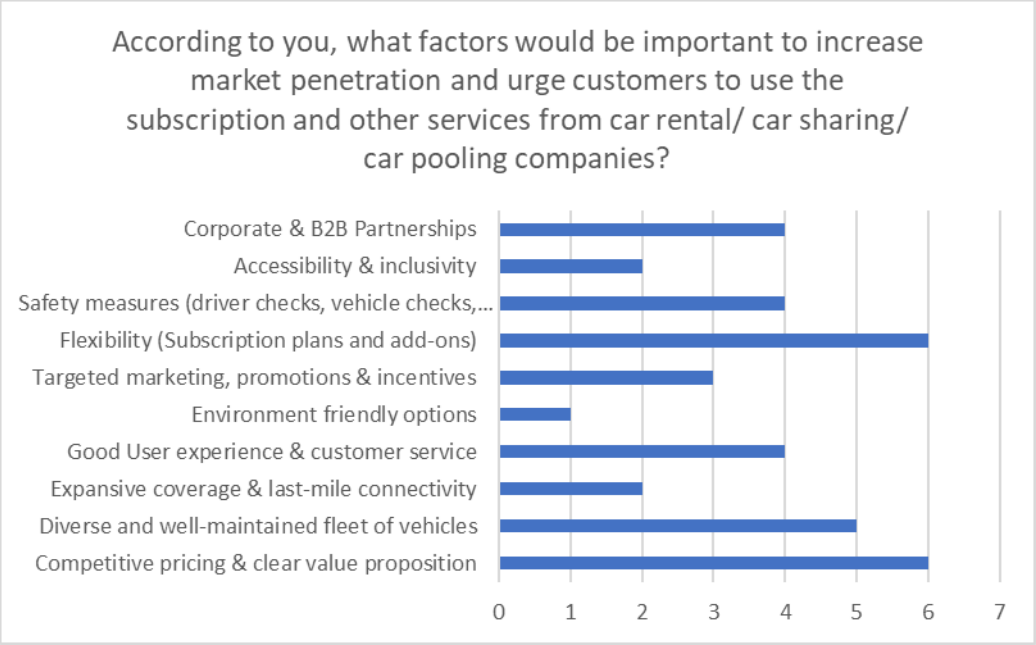


Fig. 63. Factors that would increase market penetration for subscription services - SM perspective

6.4 Evaluation of the findings – RQ 4

Understanding stakeholders' opportunities and concerns about data monetization models is the primary focus of RQ4. The author has used interview insights to back the survey insights. As mentioned by the experts who were interviewed, correctly implemented data monetization strategies have the potential to yield significant revenue streams and competitive advantages.

First, when asked what factors matter most when implementing data monetization models, 9 out of 10 OEMs said that "Regulatory compliance" was the most important consideration. From interviews, we realized that since data relates to customer privacy and has the potential to cause financial fraud as well as the misuse of private information, governments and authorities have passed stringent data security laws and regulations. OEMs claim that having a complete understanding of these rules will enable them to manage data more effectively, which will support data monetization. The importance of "technology integration" and "data anonymization and aggregation" was also emphasized when planning for implementing data monetization models. As explained by industry experts during the interviews, to avoid identifying a specific individual, data anonymization involves removing or altering personal information. Data aggregation gathers and condenses information from various sources to offer insights while protecting personal information about specific individuals. These procedures enable data analysis while maintaining privacy protection. Technology integration can expedite data processing and utilization, accelerating OEMs' efforts toward successful data monetization. Effective data anonymization and aggregation can protect customer privacy while still providing insightful data. The figure below shows how OEMs pointed out to the most important factors to be considered while implementation of data monetization BMs. Fig. 64. shows OEM perspective on important factors to be considered in data monetization.

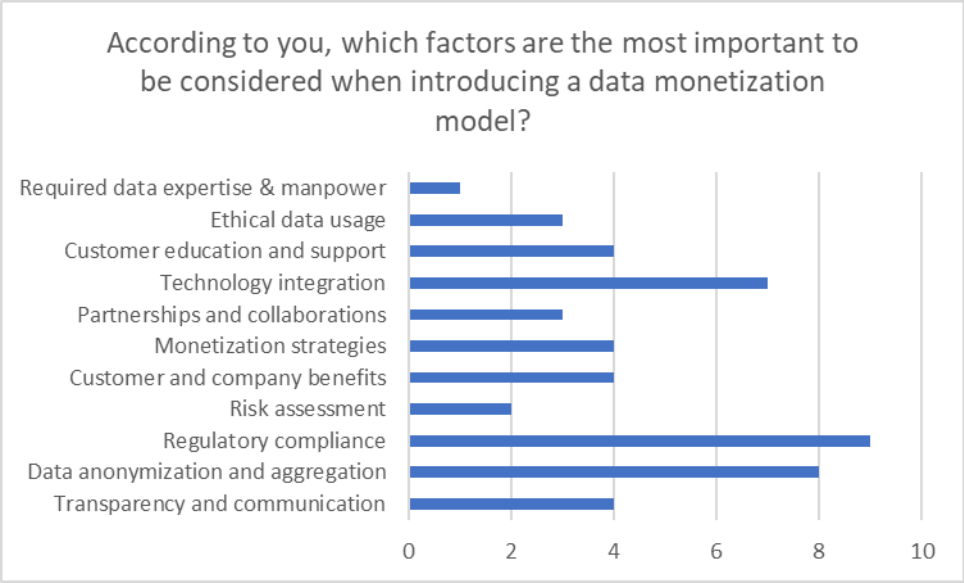


Fig. 64. Most important factors to be considered in data monetization - OEM perspective

Similar to this, PTPs identified "Government rules and regulations" and "Data privacy and security" as the most important factors to consider when implementing data monetization. Adherence to government regulations is essential to avoid legal penalties and ensure ethical data practices, while ensuring data privacy and security is critical to preserving customer trust and preventing data breaches. PTPs also highlighted "Data ownership and consent" and "Legal agreements" as important influencing factors. These components can be complicated, requiring elaborate consent management procedures and complex legal frameworks to guarantee that data use is both permitted and transparent. To stay compliant and steer clear of possible legal issues, PTPs would rather be well-prepared to handle these complexities. Fig. 65. Shows PTP perspective on important factors to be considered in data monetization.

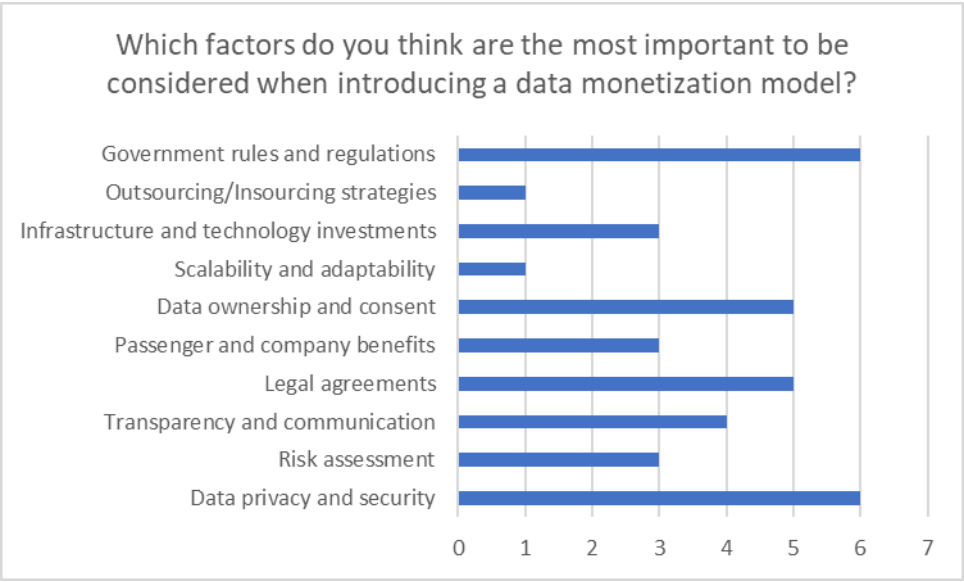


Fig. 65. Most important factors to be considered in data monetization - PTP perspective

Similarly, SMCs indicated that "Data anonymization and aggregation" and "Required data expertise and manpower" were the most important factors to take into consideration. A company may achieve substantial benefits by utilizing data expertise and appropriate workforce, which guarantees accurate data analysis, secure data management, and efficient data monetization. Professionals with the necessary skills can create and implement solid data strategies to gain competitive advantages and open up new revenue streams. SMCs also recommended "Transparency and communication" and "Technology integration" as significant factors. Processing, storing, and analysing large volumes of user, vehicle, and surrounding data effectively requires sophisticated technology integration. In order to successfully monetize data, businesses can also gain from being transparent and forthright with customers about their data sharing policies and communication strategies, fostering trust and openness. Fig. 66. shows SMCs perspective on important factors to be considered in data monetization.

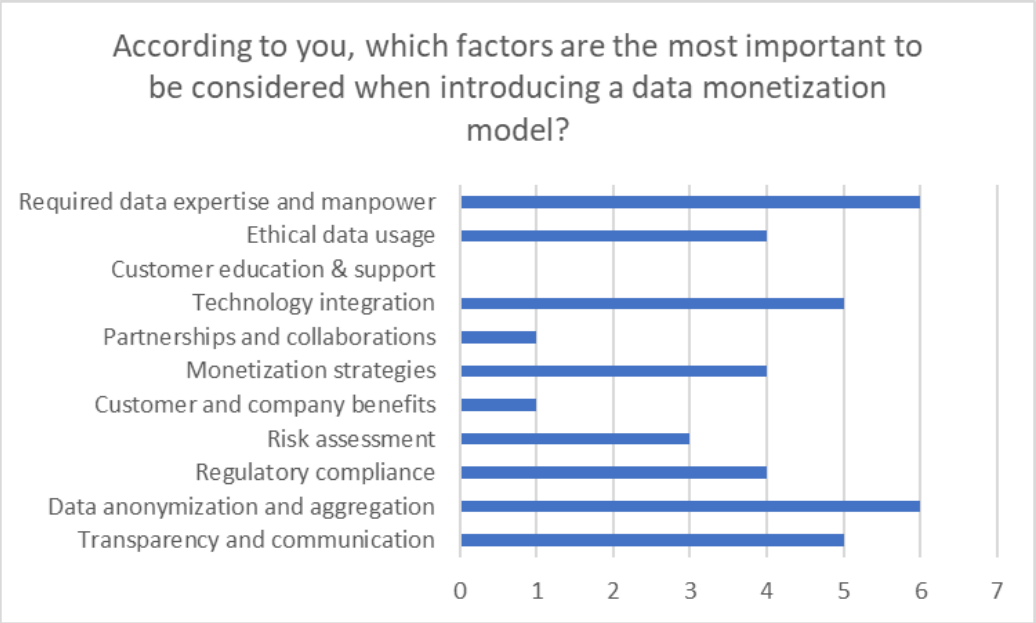


Fig. 66. Most important factors to be considered in data monetization - SMC perspective

The information collected on issues and challenges businesses would encounter when implementing data monetization business models showed a high degree of complexity. The OEMs firmly believed that "data-related issues" and "data privacy and security" constituted the biggest barriers. The interviewees firmly believed that all stakeholders, including policymakers, are struggling with these complicated issues. In order to safeguard confidential information, strict protocols must be followed. Additionally, agreements and guidelines must be made regarding standardization and ownership of data in order to manage it responsibly and openly. OEMs also identified "IT infrastructure investments" as a significant barrier. Developing and maintaining the network, hardware, and software systems required to support data monetization initiatives is an expensive venture that involves a significant investment in building an efficient IT infrastructure. The most and least significant barriers are depicted in the Fig.67 below.

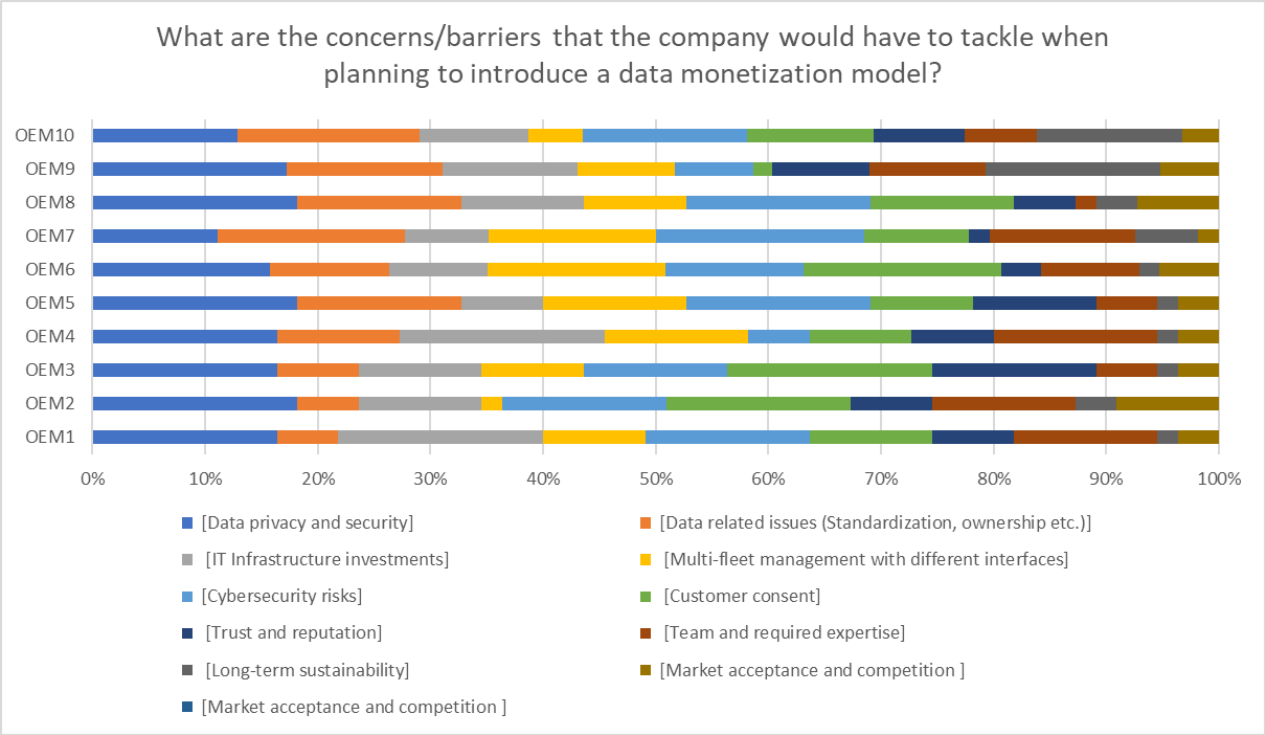
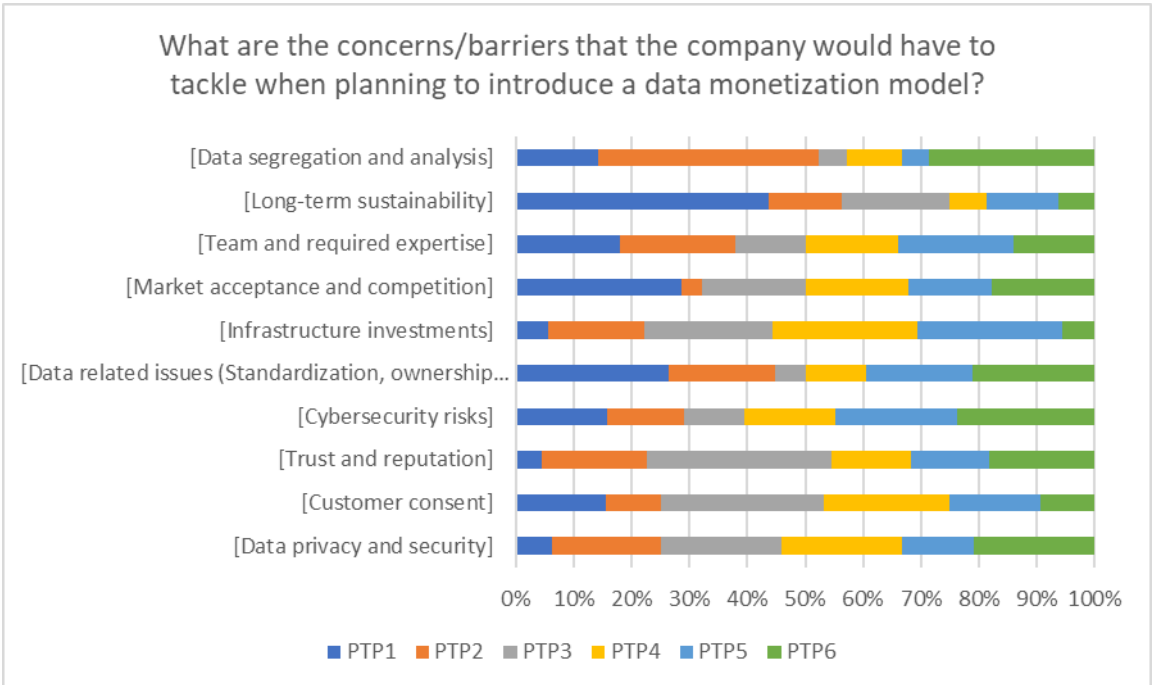


Fig. 67. Challenges and concerns in implementing data monetization models - OEM perspective

PTPs similarly stated that "Data privacy and security" and "Team and required expertise" were the biggest obstacles they could face when deciding to implement data monetization models. As PTPs have not primarily focused on data-centric business models, they believe that developing the requisite IT infrastructure and successfully monetizing data would require a skilled workforce and specialized expertise. The concerns and barriers that PTPs have identified are shown in the graphical Fig. 68 below.



Finally, SMCs expressed their concerns about the implementation of data monetization strategies. "Data privacy and security" was cited as the biggest obstacle, highlighting the necessity of major efforts to overcome this hurdle. They also identified "Data-related issues" and "Cybersecurity risks" as the two main challenges. For SMCs, offering excellent services is their biggest value proposition, so they cannot afford data breaches or cybersecurity-related problems. Significant concerns were also raised about other data-related issues, including standardization, anonymization, and data ownership. Fig. 69 shows the barriers that SCMs would have when introducing a data monetization model.

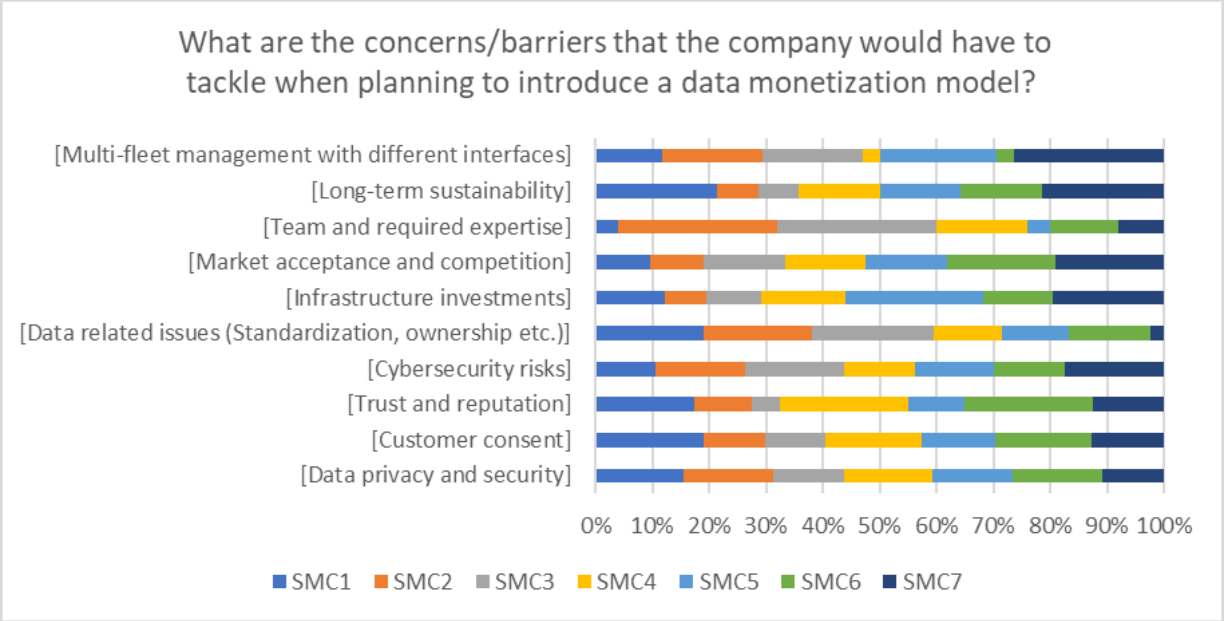


Fig. 69.Challenges and concerns in implementing data monetization models - SMC perspective

7. Final insights and future opportunities in CASE mobility: Strategic pathways for stakeholders

Based on the insights learned from the survey and detailed backing to that from the interviews conducted, the author sees a broad spectrum of possibilities for CASE mobility and its business potential. Initiatives aimed at AVs and shared mobility practices can benefit OEMs, PTPs, and SMCs collectively. As mentioned in the interviews, through the use of MaaS as a platform, stakeholders can concentrate their efforts on identifying customer preferences and pain points, working together to find effective solutions to these challenges.

One expert also mentioned in the interview that businesses could find great success with vehicle subscription models and data monetization techniques as important components of their business portfolios. By providing customers with a range of vehicle options, flexibility, and convenience without requiring long-term commitments, traffic details as well as advanced analytics, they can increase customer satisfaction and loyalty. These BMs have the potential to increase the company's customer base and generate high-margin revenue. Businesses can concentrate on gathering data from their

vehicles, identifying partners who would be interested in buying this data, and making more money as a result. The additional money received can be reinvested into improving these services. Furthermore, by offering more in-depth understanding of consumer behaviour and preferences, the data gathered can assist businesses in improving their products and services.
But in order to fully utilize these BMs, substantial resources, including advanced technology and infrastructure investments will be needed. In order to foster innovation and development in CASE mobility, government support will be essential, both in terms of investments and regulations. To manage the complexity of these new BMs and make sure they meet or exceed customer expectations, a skilled workforce will also be required.

OEMs, PTPs, and SMCs can revolutionize the mobility landscape by tackling these issues and combining their strengths to provide better, more effective, and customer-focused solutions. Concluding the thesis, the author derives several key points from the surveys and interviews that stakeholders can look forward to. These points are based on survey and interview insights and provide a general understanding of future opportunities. As per the industry experts:

- **Partnerships and Strategic Alliances**: One possible course of action for stakeholders is to concentrate on cooperative efforts and relationships. Through the expertise that these alliances bring from different segments, the automotive industry can become more innovative and efficient.

- **Technology Integration and Advancements**: In order to create seamless products and services, stakeholders must keep developing their technology. Effective use of data will be essential to managing and improving these offerings.

- **Innovation and Development**: Constant innovation has propelled the automotive industry's advancement. Sustaining this emphasis on innovation is imperative for forthcoming expansion and advancement.

- **Ownership to Usage-Based BMs**: As consumer preferences change, usage-based BMs might possibly overtake the traditional ownership trend soon. For emotional or other reasons, some people may still own vehicles, but for most people, shared services offer flexibility and low commitment.

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