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AUTOMOTIVE INNOVATION:

Customer preferences for their journey into the future of the automotive industry

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Abstract

The automotive industry is currently experiencing the biggest transformation in its history. Pressure from technological disruption, the emergence of new competitors and changing consumer demands require established OEMs to revise and innovate their business models. This work project takes four deep dives to investigate automotive innovation from an external and internal perspective in the context of German premium OEMs. Firstly, through collecting primary data on consumer preferences, it discloses major trends in their changing demands and emphasizes its driving force on the innovation process. As a further external perspective, the influence of (alternative) M&A announcements on the automotive OEM's equity value is proposed to be examined by means of an event study to shed light on the shareholders' evaluation of external innovation. In contrast, the third section looks at organizational innovation from the inside. By reviewing a practical case, it elaborates on the importance of organizational separation for corporate venturing to exploit existing capabilities to prepare for future challenges. Lastly, it provides a real-world example of corporate innovation by examining the case of integrating circular practices in the product lifecycle. In a critical comparison with recent literature, recommendations for such transformations are drawn. Overall, this work project provides insights into different sections of automotive OEMs and their innovation processes to defend their position as industry leaders.

Keywords

Automotive innovation, automotive trends, German automotive OEMs, CASE-technologies, event study, automotive M&A, stock market reactions, automotive partnerships, circular economy, tech subsidiary, organizational ambidexterity, innovative product portfolio, customer journey, future customer preferences, future generation

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Abbreviations

ADAS	Advanced driver assistance system
ADS	Automated driving system
AI	Adjacent innovation
API	Application programming interface
BEV	Battery electric vehicle
BSI	British Standards Institution
CAPM	Capital asset pricing model
CAR	Cumulative abnormal return
CASE	Connected, autonomous, shared, electric
CE	Circular economy
CI	Core innovation
CO_2	Carbon dioxide
CRSP	Center for research in security prices
CSCM	Circular supply chain management
CUSIP	Committee on uniform security identification procedures
CoVh	Connected Vehicle
DDT	Dynamic driving task
DfS	Design for sustainability
EMF	Ellen MacArthur Foundation
EMH	Efficient market hypothesis
EoL	End-of-Life
EUR	Euro

EV	Electric vehicle
FCEV	Fuel cell electric vehicle
GHG	Greenhouse gases
GLS	Generalized least square method
GPS	Global positioning system
ICE	Internal combustion engine
JV	Joint venture
KPI	Key performance indicator
M&A	Merger & acquisition
ODD	Operational design domain
OEM	Original equipment manufacturer
OLS	Ordinary least squares method
PEST	Political, economic, socio-Cultural, technological
PHEV	Plug-in hybrid vehicle
RBV	Resource-based view
SCM	Supply chain management
TI	Transformational innovation
VUCA	Volatility, uncertainty, complexity, ambiguity
WOM	Word-of-mouth

Group part – Automotive Innovation

1. Introduction

The automotive industry finds itself in the "biggest mobility revolution since the invention of the car" (Dobrindt 2016). This is the view of the former German federal minister of transport and digital infrastructure. Additionally, Hyundai's President and CEO has recently stated that "the automotive industry will evolve more in the next decade than it has in the previous century […] to keep up with the future of mobility, it is not enough to only bring zero-emission cars on to the road, we need to invest in technologies that will improve the way we get around […]" (Cole 2021).

The automotive industry represents the most innovative sector in Europe with R&D investments of EUR 59 billion which results in a share of 34% of the total R&D investment sum by European companies in 2020 (Grassano 2022). Thereof, German car manufacturers spent EUR 24 billion which corresponds to a share of about 41%, making them the main contributor of R&D investments in Europe (ACEA 2022, GTAI 2022). Among these, the most innovative original equipment manufacturers (OEMs) are found within the premium segment and are represented by Audi, BMW, and Mercedes-Benz (Bratzel 2021). These manufacturers are also among the world's leading patent applicants, clearly depicting the innovation leadership on which the industry is based (ACEA 2017).

However, due to changing external factors like new customer expectations with regard to the digital capabilities of a car (Kempf et al. 2021) or more stringent measures toward sustainability requirements, the automotive industry finds itself in a twofold transition (Brown et al. 2021). On the one hand, the digital transition changing the focus from hardware to software-defined vehicles. Along with this comes the rise of the CASE framework which refers to connectivity, autonomous driving, subscription models, and electrification. On the other hand, the industry

faces a green transition through new policy regulations and changing customer preferences. Thereby, automotive OEMs are facing high degrees of unpredictability and uncertainty. Moreover, this transition leads to new market dynamics wherefore players from other industries like IT or communications technology are pursuing strategies to enter the market (Brown et al. 2021).

To tackle these challenges and remain their established market position, traditional automotive OEMs need to innovate and adapt the way innovations are created (Talay, Calantone and Voorhees 2014). This leads to the necessity of building ecosystems to foster alternative ways of collaboration.

The presented importance of the automotive sector in Europe, especially that of German premium OEMs along with the changing market conditions and the associated challenges regarding innovation strategies lead to the starting point of this study. It follows the research question "How do German premium automotive OEMs have to adapt to remain their innovation leadership within the industry?" and focuses on the three German OEMs Audi, BMW, and Mercedes-Benz.

This is achieved by analyzing the historic importance and the future strategies of the beforementioned OEMs in Chapter 3. Afterward, chapter 4 comprises Porter's five forces analysis to elaborate on the current market dynamics. Following that, a comprehensive review of trends and innovations affecting the automotive industry is performed. In Chapter 6, business ecosystems are reviewed as one alternative on how established OEMs can create innovations. Chapter 7 looks at the change in customer preferences, especially after the Covid-19 pandemic. From Chapter 8 onwards, this work comprises the individual parts of the authors. Through the analysis in the individual chapters, the authors are deeply examining the research question on different contextual levels. Chapters 8 and 9 analyze the subject from an external point of view, whereas chapter 8 looks at external pressures arising from changing customer preferences.

Chapter 9 focuses on the shareholders' point of view by analyzing stock market reactions to investments of automotive OEMs in the field of CASE technologies. From chapter 10 onwards, this work observes the internal perspective of two German premium automotive OEMs. Chapter 10 comprises an analysis of how established OEMs can foster innovation organizationally through the contribution of a separate entity. It includes a case study of a tech subsidiary of a German automotive premium OEM. Lastly, this is followed by an examination of one specific type of innovation, the implementation of circular strategies. Through a case study of the transformation of a linear produced interior part into a circular one, best practices regarding the operationalization of circular strategies are derived. Lastly, this study concludes its findings in chapter 12 and gives recommendations for future academic research.

2. The automotive industry

The automotive industry includes not only the designers and manufacturers of vehicles but also those who innovate and transform the products. It includes the production, wholesaling, retailing, and maintenance of motor vehicles and includes all the companies that are involved in the corresponding activities (Bell Rae n.d.). The history of the industry began in Germany at the end of the 19th century, with the first developments of the fuel-powered engine, followed by an USA dominated first half of the 20th century. In 1980, Japan overtook the USA to become the industry leader and today, China leads the market in car-production numbers (Wondershare EdrawMax n.d.). In 2022, car sales within the automotive industry declined by 3.3%. Nevertheless, it is expected to reach a value of $3.7 trillion worldwide in 2022 (ibisworld 2022). In the medium term, it is expected that the market value will grow to an estimate of $4.6 trillion in 2030 (Precedence Research n.d.). The value chain of an OEM comprises some primary activities, which are directly linked to production and sales: inbound logistics, which consists of the reception of raw materials and placing them on the production line; operations, which

includes the entire production of the car and its components, nowadays, OEMs have spread this part around the globe to reduce costs; outbound logistics, including the entire process of delivering the vehicle from the end of its production to the final customer; marketing and sales, responsible for capturing the consumer's attention and creating links with the right targets to generate as many leads as possible that might turn into end customers through advertising and marketing; finally, service, which includes customer support in the fields of aftersales and maintenance, which OEMs must provide to increase customer retention and improve the brand image to its consumers and the public (Wondershare EdrawMax n.d.). Nowadays, the car is the main mean of transport worldwide, although with a slight decrease in the growth trend, it is still very important, especially in developed countries. One of the biggest trends is the ongoing electrification of vehicles, a crucial factor influencing the whole industry landscape. The automotive market comprises several OEMs that are considered as premium because of their higher price positions and superior quality (Bratzel 2021).

3. Established German automotive premium OEMs

German automotive OEMs are among the world's leading producers of premium vehicles. The global share of premium branded vehicles that are produced by German OEMs stands at 65%. Within this share, the three major contributors are Audi, BMW, and Mercedes-Benz. Out of 9.5 premium vehicles sold worldwide in 2016, they accounted for 6 million, which puts them far above their international competitors (Bormann et al. 2018). The term premium used in this context is understood according to the definition outlined by the Friedrich-Ebert-Stiftung: "It refers to high-quality vehicles with respect to technology and comfort. This includes both luxury sedans and similarly furnished smaller vehicles. Many new developments and innovations are first used in the premium segment and slowly spread into the mass-market segment." (Bormann et al. 2018, 9).

The established German premium OEMs have a longstanding tradition that dates back to the 19th century. In 1888, the world's first petrol-powered car was invented by Carl Benz who paved the way for advancing Germany as a country of car manufacturers with his pioneer work (Staples 2019). Especially in the post-second-world war phase, the automotive industry is seen as the engine of the German industry and the driver of the German economic miracle. Back in the 1960s and 1970s, the automotive industry was fragmented into luxury and low-class vehicles. The emergence of the oil crisis and the growing prosperity of the middle class caused the automotive players to a strategic shift. Thereof, the segment of premium cars evolved. Brands like BMW and Mercedes-Benz started to adapt their strategies and revised their product portfolios (Nöhl 2013).

Fast forward to 2021, the German automotive industry is the European car production leader with more than 3.1 million units produced in German plants. Beyond that, the export of automobiles accounts for more than 13% of all German exports in 2021, making the industry the largest exporter in the country. Additionally, the industry is Germany's most innovative sector since 34.1% of the total German industry R&D expenditure is spent by it (GTAI 2022). This is also reflected by the number of patents granted to the German automotive sector which stands at 2,587, placing the German OEMs among the world's leading patent applicants (ACEA 2017). This represents the R&D leadership on which the industry is based. German premium OEMs stand for producing innovative products at a high-quality level, which constitutes their competitive advantage.

In terms of revenues, the German automotive industry stands at EUR 410.9 billion in 2021, split into EUR 136.9 billion generated in the domestic market and EUR 274 billion in foreign markets. Thereby, exports make up more than 65% of total revenue (GTAI 2022). The largest export markets for German OEMs are China, the U.S., and the UK with a cumulative share of about 36% (Destatis 2022).

To retain their market position and preserve their competitive advantage, the German manufacturers plan to invest EUR 150 billion in digitalization, electrification and drive systems, hydrogen technology, and safety technologies in the forthcoming years (GTAI 2022).

The future strategic positioning of the three major German premium OEMs, Audi, BMW, and Mercedes-Benz is outlined in the following section.

Audi operates in the segment of premium cars offering individual mobility solutions with a focus on sporty vehicles with a progressive design. The company announced its new strategy in 2021 under the framework “Vorsprung 2030”. The main aspects are that from 2026 onwards all product launches will be fully electric. The discontinuation of internal combustion engines (ICEs) will happen in 2033, besides China, where a possible prolongation is reviewed. Audi plans to differentiate itself through high quality and design and commits itself to remain the reputation of being the innovation driver of the industry. Among others, this is pursued by offering a holistic ecosystem for electric and autonomous driving, thereby creating an immersive user experience. Moreover, the strategy focuses on embedding ESG (environmental – social – governance) aspects in decision processes as well as in products and services aimed at becoming the industry leader in terms of sustainability, social, and technology (Audi AG 2022).

BMW manufactures vehicles for the premium and luxury segment. The strategic focus lies on offering first-class individual mobility while contributing to sustainable development. This is achieved through objectives aimed at reducing CO_2 emissions in the use phase of a vehicle, the production, and along the supply chain. With regards to electrification, deliveries of electrified vehicles are planned to reach 30% by 2025, and by 2030 50% of all delivered vehicles should be fully electric.

Starting from 2025 onwards, the company will introduce a new vehicle platform on which the fully electric product line-up of the “Neue Klasse” will be produced. With this product shift,

the company aims to be the industry leader in terms of digitalization, electrification, and sustainability (BMW Group 2022).

Mercedes-Benz is currently implementing a change in strategy which shifts its focus to the upper-class segment. The company wants to serve the market with top-end luxury and core-luxury models which promise higher and more stable returns. Therefore, it reduces its variants in the entry segment from seven to four but simultaneously aims to remain its sales volume. The stated goal is to become the world's most valuable luxury car manufacturer. This is to be achieved by concentrating on markets with a strong buyership for luxurious cars like China. In terms of electrification, the company plans to become fully electric by 2030 (Mercedes-Benz 2022).

The viability of the pronounced strategies is investigated in the following chapter by conducting Porter's 5-forces analysis of the automotive industry, especially focusing on the new industry players.

4. Porter's five forces

The following section of this work project will take an analytical approach on the competitive structure of the German automotive market from the perspective of a German premium OEM by the means of Porter's Five Forces Model. This model was formulated by Michael Porter in 1979 and is used to identify as well as analyze five major competitive forces affecting every industry and determine its weaknesses and strengths. It helps to understand an industry's structure to explain the differences in profitability between various industries and later formulate business strategies based on the firm's position in the competitive landscape. The referred forces are composed of the competition within the industry, the threat of new entrants, the power of suppliers as well as customers, and the threat of substitution (Porter 1979).

4.1 Competition within the industry

The premium automotive segment is highly competitive within itself. The German premium brands include Mercedes-Benz, BMW, Audi, and Porsche and are complemented by the international brands Tesla, Volvo, Land Rover, Lexus, Alfa Romeo, and multiple others. Despite the high number of international competitors, there is a strong concentration around the three big German players, namely Mercedes-Benz, BMW, and Audi. Considering newly registered cars in 2021 in Germany, they were holding a share of 8.6%, 8.5%, and 7% respectively (VDIK 2022). When focusing solely on the premium segment, the dominance becomes even more obvious.

While the trio faces raising competition from international brands such as Tesla with annual growth rates far above 100% (VDIK 2022), they are in a comfortable position to recover from the influences of the corona pandemic in the German market due to high brand loyalty of German consumers (Automobile Woche 2018). Despite facing the pressure of global chip shortage, raising energy prices, and macroeconomic uncertainties on the whole industry, the premium car segment is expected to grow at an annual rate of 8-14% and therefore exceed the rest of the industry (McKinsey 2022). Following this trend, the OEMs are increasing their focus on the high-margin luxurious models while decreasing their offer in the smaller car segment, which eventually leads to further consolidation of the market. While the German OEMs seem to have a leading position compared to international competitors, the competition between them is intense. Driven by the highest R&D expenditure (EUR 28.1 billion) in the industry, they keep leapfrogging each other with higher sales numbers (Germany Trade & Invest 2022).

4.2 Threat of new entrants

The threat of new entrants can be considered mediocre. The combination of high initial investments, economies of scale, network effects from distribution and services as well as long-

established partnerships on the supply chain make it extremely difficult to enter the industry from an OEM side. Furthermore, consumer attitudes in the German market are still heavily favoring German OEMs over emerging Chinese competition (Tagesschau 2022). Nevertheless, Tesla has proven over the past decade that it is possible to enter the industry and challenge established brands. However, the biggest risk comes from technology platforms and new business models, exploiting the inertia of the traditional OEMs in adapting to the fundamental changes transforming the industry, such as electrification (Tesla and now Polestar) or autonomous driving (Waymo and Baidu). The traditional German OEMs will most likely continue to dominate in their key competence of producing high-end cars. Although, they must be aware of the risk of becoming dependent upon technology providers and software firms shifting their focus towards the automotive sector.

4.3 Power of suppliers

With firms like Bosch, Continental, ZF, or Mahle, Germany is the global leader in OEM supplies. The suppliers generated an industry turnover of EUR 79.7 billion in 2021 (out of the EUR 410.9 billion total revenue of the German automotive industry). However, in contrast to the OEMs, the supply side is very scattered, with 85% of the firms being small or medium-sized companies (Germany Trade & Invest 2022). Therefore, for many decades, the power structure between the suppliers and the dominant German OEMs was clearly defined. They dictated prices and contract conditions at the expense of the suppliers. Recently, the supply side started to resist the continuous pressure from the OEM side due to increasingly difficult (external) conditions. The relationship got so bad that the powerful German Association of the Automotive Industry (VDA) had to step in and mediate between the parties. Following trends led to the tense situation: Firstly, despite the pandemic and the Ukraine war, the OEMs were still able to increase profit margins (MB 12.4%, BMW 10.3%, VW 6.4% in 2021) through cost-

cutting programs and increased focus on high-margin luxury models. Suppliers, on the other hand, must deal with extreme cost increases in energy and raw materials, further reducing the already narrow profit margins (ZF 3.7%, Mahle 1.5%, Bosch 0.7% in 2021) (Handelsblatt 2022). Often, the suppliers are tied to long-term contracts, making it almost impossible to pass on the cost increases and therefore protecting the OEMs against rising energy prices (Roland Berger 2022). Further, the current industry transformation will have drastic consequences for ICE-focused suppliers which will experience a sharp decrease in demand and are therefore urged to adapt their business model to future-ready technologies. Nevertheless, the OEMs also depend on their intact supply chains due to just-in-time delivery and modular production and are thus trying to avoid the costly disruption of it. The power of suppliers seems therefore moderate.

4.4 Power of consumers

Due to the variety of premium brands and their highly comparable offers, the individual buyer faces many substitutable options. The access to information about pricing, performance, or customer reviews about certain features allows the consumer to make educated choices. Furthermore, it is projected that the global fleet management market will experience significant growth from EUR 19 billion in 2020 to EUR 50.6 billion in 2030 (Allied Market Research 2022) and additionally, according to McKinsey (2016), every tenth car sold in 2030 will be a shared vehicle. This will lead to the emergence of more powerful key account customers with a stronger bargaining position in negotiations.

However, currently, the customer sentiment is dealing with rising inflation and soaring cost of living, which leads to a reduction in purchasing power across all income brackets. This will most likely negatively influence people's long-term purchase plans for luxury goods and therefore endanger OEMs' sales expectations (Roland Berger 2022).

Nevertheless, the overall power of consumers is relatively high.

4.5 Threat of substitution

As previously stated, the German premium OEMs clearly dominate the German market. Nevertheless, the consumer has a wide range of other (international) premium brands to choose from with relatively low switching costs. Furthermore, they can upgrade to luxury-class brands such as Bentley or Aston Martin or downgrade to middle-class brands such as the domestic Volkswagen brand or the French Peugeot brand. The readiness to do so depends on the individual willingness to pay, brand loyalty, and one's expectations about the level of quality. Next to the risk of being substituted by other car brands, there is also the threat coming from new business models. In Germany, car subscription platforms like FINN or ViveLaCar disrupt the concept of car ownership by offering new service models to fill the gap between leasing and short-term renting. While premium car owners are more willing to make use of car-sharing platforms or chauffeuring services compared to mass-market car owners, only 5% of them would give up their own car for mobility services (McKinsey 2019).

Customers of premium OEMs can be split into utilitarian shoppers, valuing functions, and hedonic shoppers, valuing the status that comes along. Other mobility providers, such as bikes or trains, will fail to satisfy the needs of convenience or reputation that a premium car buyer expects (Beverly Hills Magazin 2022). Overall, the threat of substitution is moderate to low.

While the model gives a good overview of the firm's competitive rivalry in the industry and helps to identify imperfect markets, it leaves room for criticism. The model only gives a snapshot of the past and ignores the highly dynamic and constantly changing conditions in the modern-day business world. It seems necessary to extend the five forces with the PEST (Political, Economic, Socio-Cultural, and Technological) framework to capture external influences and the industry dynamism (Goyal 2021). This would provide further insights into

the overarching transitions the German premium OEMs are currently facing. Technological transformations such as electrification, the race to autonomous driving, or digitalization represent tremendous challenges for the industry. Furthermore, political regulations and changing consumer preferences increase the pressure on OEMs to adapt fast. Later sections of the work project will elaborate on those topics in more detail.

5. Innovation and recent trends in the automotive industry

5.1 Shift from hardware to software-defined vehicles

Over the last century, automotive manufacturers have mainly differentiated themselves through hardware components, especially through the technology and engineering of the engine (Burkacky et al. 2018). This trend is about to shift to the field of electronic hardware and software whereas it is expected by the former Volkswagen chairman Herbert Diess that those two factors will have an impact of 60-70% on vehicle product differentiation (Diess 2021). Currently, the costs associated with software stand at 10% of the total vehicle material costs. By 2030, it is expected that this will increase to 50%, thereby transforming cars into software-defined vehicles (Zhou et al. 2021).

According to Zhou et al. (2021, 2), a software-defined vehicle is understood as a concept in which the ‘quantity and value of software (including electronic hardware) exceeds that of the mechanical hardware; furthermore, it reflects the gradual transformation of automobiles from highly electromechanical terminals to intelligent, expandable mobile electronic terminals that can be continuously upgraded.

The disruption toward software-defined vehicles in the automotive industry was mainly initiated by Tesla and due to its pioneer work, the company has encompassed the market value of Toyota and Volkswagen combined (Kempf et al. 2021). The established automotive OEMs have recognized the need to tackle the issue and Volkswagen for example has founded its own

software company Cariad which is responsible for the software development for the whole Volkswagen group. Despite its goal of being the leading technology platform for the automotive industry (CARIAD 2022), recent reports show that the company faces difficulties in delivering software and delays in product development processes (Tyborski 2022).

The driving forces behind software-defined vehicles are threefold: customer expectations, industry development requirements, and value chain transfer (Zhou et al. 2021).

Customers expect that vehicles can be seamlessly integrated into their digital ecosystem which creates higher customer satisfaction. Additionally, through smartphones and computers, customer expectations have risen to the level that products and services are updateable and upgradeable with real-time data (Kempf et al. 2021).

Through the rise of the CASE technologies, OEMs are required to adapt software and algorithm capabilities accordingly. Especially, through the advancement of autonomous and connected driving technologies, the amount of data processing through algorithms is expected to rise sharply (Burkacky et al. 2018).

The latter driver describes the reallocation of economic value between hardware and software parts. Hardware parts are largely commercialized and become white-label products, whereas software is evolving into the new driving force of economic value creation in the automotive industry. Especially through reoccurring revenues that are generated through over-the-air upgrades and monthly subscription services of features like engine performance or automated driving capabilities, automotive OEMs are expected to generate continuous contributions to their cash flows (Zhou et al. 2021).

5.2 Alternative drives and sustainability

5.2.1 Sustainability development

Sustainability is besides urbanization, individualization, and digitization one of the four

megatrends affecting all areas of society (Bormann et al. 2018), particularly the automotive industry has an impact on the development of sustainability issues since the transport sector accounts for 24% of the EU's GHG emissions (Cornet et al. 2019). Additionally, the 2021 "Transport Outlook" by the OECD's International Transport Forum finds that passenger traffic will increase 2.3-fold and transport-related CO_2 emissions will raise by 16% by 2050. This rise is expected even if today's planned decarbonization measurements are implemented since the increased transport demand will offset them (International Transport Forum 2021).

The drivers behind sustainability efforts in the automotive industry fall into three categories: normative, imitative, and regulative pressures (Lo and Shiah 2016). Normative pressures arise from the market and in the case of automotive manufacturers, customers are the most demanding stakeholder group with regard to offering ecologically sustainable products (Hetterich et al. 2012). Imitative pressure is related to the actions of competitors and the strive to gain a competitive advantage. A survey conducted by Thun and Müller (2010) finds that competitor actions are the second-highest force to implement sustainable measurements in the automotive industry. Regarding regulative pressures, scholars find that it is the main external driver to shift to sustainable practices since laws and regulations for automotive companies have become stricter over the last years (Szász, Csíki and Rácz 2021).

The topic of sustainability also ranks high on the OEM's agendas due to issues like technical advancements with regard to lightweight construction, and a shift in the drivetrain from ICEs to electric motors and batteries which is assessed later in this chapter (Wellbrock et al. 2020).

One means to achieve sustainability goals is seen in the concept of the circular economy. With regard to automobiles, according to the World Economic Forum, a circular car is understood as a theoretical concept that maximizes value to society, the environment, and the economy and utilizes materials in the most efficient way (Holst et al. 2020). The concept of a CE in the context of a German premium OEM is analyzed more thoroughly in the individual chapter 11.

5.2.2 Alternative drive trains

The topic of electrification is one of the four emerging trends of the CASE (connectivity, autonomous driving, shared mobility, and electrification) framework that is currently disrupting the automotive industry (Cornet et al. 2019, Strategy& n.d.). In 2035, the market of electric powertrains and batteries is estimated at $238 billion in Europe of which the major share is accounted for by battery cells and packs, thereby emphasizing the strategic relevance for automotive OEMs. Nevertheless, it is expected that battery cells and systems still represent the largest cost share in electric powertrains (Strategy& n.d.).

Electric vehicles which include battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) make up 18% of newly registered passenger cars in the EU in 2021. This represents an increase from about 11% in 2020 to 18% in 2021 (European Environment Agency 2022). This makes the EU the worldwide leading market regarding the share of newly registered EVs. Globally, electric cars have a market share of 9.5% in 2021 which is more than twice as much as last year. From a supply side, the number of EV models currently stands at around 450 (International Energy Agency 2022), whereas this will sharply increase by 2025 with over 500 new models entering the market (McKinsey 2022).

From a legal point of view, the topic is forced by the EU with several requirements. One of them is that by 2030, the EU aims for 30 million zero-emission vehicles on European roads (European Commission 2020). Additionally, from 2035 onward all newly registered vehicles are obliged to emit zero emissions (Council of the European Union 2022). With these strict regulations, the EU aims to reach its goal of climate neutrality by 2050, and simultaneously the dissemination of EVs is accelerated since they count as emission-free.

Electrified vehicles experience increased demand among consumers who intend to buy a car in the next two years. Globally, 52% could imagine purchasing an EV as their next personal car, especially driven by the preference for fully electric vehicles which tripled from 2020 to 2022

according to the EY Mobility Consumer Index (Miller, Cardell and Batra 2022).

Contrarily, the most relevant barrier to the widespread adoption of EVs is found in the availability of charging stations (Miller, Cardell and Batra 2022, McKinsey 2022). As the Electric Vehicle Index by McKinsey found, Germany is lacking far behind China with a ratio of 27 EVs per charging station while China has one of 7 (McKinsey 2022). To match the growing EV penetration, it is estimated that the charging infrastructure needs to grow by a factor of 12 by 2030 which translates into the addition of 22 million charging stations per year on a global basis (International Energy Agency 2022).

Fuel cell electric vehicles (FCEVs) belong to the group of zero-emissions vehicles. FCEVs store hydrogen on board which is converted through a fuel cell into electricity which ultimately powers an electric motor (International Energy Agency 2022). Compared to BEVs, FCEVs have the advantage of faster refueling times, smaller required weight and volume for energy storage, and the technology can be scaled up more easily to generate more electricity in a vehicle (Arena, Spera and Laguardia 2017).

The total number of FCEVs worldwide passed the 50,000-unit mark in the last year with 51,437 FCEVs driving on the road. It is worthwhile to note that four countries, namely South Korea, the U.S., China, and Japan, have a share of over 90% of the global FCEV stock (Samsun et al. 2022). Thereof, South Korea is the leader in FCEV deployment and almost doubled its stock between 2020 and 2021 (International Energy Agency 2022). Looking at the distribution by vehicle class, passenger cars have the highest share with over 4/5, the remainder is equally shared between trucks and buses (Samsun et al. 2022). Currently, the most relevant automotive players regarding FCEVs are Hyundai and Toyota with their respective models Nexo and Mirai who both hold an equal share of the market (Zhang et al. 2022). The German OEMs do not offer FCEVs for sale to customers at the moment. Solely, BMW has introduced the iX5 Hydrogen in 2022 which will be a small batch production car of 100 units meant for testing in

the most recent FCEV markets (BMW Group 2022).

Looking ahead, various nations have set out ambitious targets and roadmaps for upscaling the deployment of FCEVs. China has deployed the Technology Roadmap for Energy-saving and New Energy Vehicles which targets 50,000-100,000 FCEVs by 2025 and one million FCEVs by 2035 (China Society of Automotive Engineers 2020). The U.S. has introduced the Roadmap to a U.S. Hydrogen Economy which sets the goals of 150,000 FCEVs by 2025 and 1.2 million by 2035 (Fuel Cell & Hydrogen Energy Association 2020). Accordingly, the Hydrogen Roadmap Europe follows equally ambitious goals with 300,000 FCEVs in 2025 and 1.8 million by 2035 (European Union 2019).

Despite the ambitious targets by policymakers, the dissemination of the technology is predicted to happen rather in the long than in the short term since it faces several barriers like the availability of hydrogen refuel stations and the high upfront costs for consumers (Arena, Spera and Laguardia 2017). Nevertheless, FCEVs have the potential to complement the offer of EV technologies in the automotive sector and contribute to achieving global emission reduction objectives (Samsun et al. 2022).

5.3 Connected cars

Another technological development disrupting the status quo and turning into one of the four major industry trends is the connectivity of vehicles. With the goal of reaching accident-free car travel or at least drastically reducing casualty rates and traffic congestion, as well as developing smart mobility systems and services, connected vehicles (CoVh) are at the forefront of collaborative research. Through the collection of information and the creation of data-centered environments, CoVhs are key enablers of a wide range of applications and services focused on safety, convenience, and environmental protection (Abdelkader, Elgazzar and Khamis 2021). According to H. Ahmed, Y. Huang, P. Lu and R. Bridgelall (2022), a CV is “a

car that is equipped with a technology enabling it to connect and communicate with other devices within the car, and also to other surrounding cars and external networks (e.g., internet, navigation, environment data, etc.)“. To fully grasp the impact that CoVhs eventually will have on the industry, it is necessary to briefly look into the technological developments enabling them.

The basic requirement is an active connection between the car and the internet. This allows the driver to access vehicle communication systems and various other services like over-the-air updates or GPS systems. Further, the connected communication systems are either native-build-in by the OEM or include external devices from the after-market (e.g., smart phones). The two different connectivity systems currently used to establish connections between the driver and other devices are embedded systems and tethered systems. While the former includes a chipset, which holds the functions of a data flow management system controlling the information flow in the motherboard, as well as in-build signal receivers and transmitters, the latter provides the hardware necessary to connect the car to the driver’s phone. The actual communication can then take place in seven different channels. Currently, the three predominate ones are Vehicle-to-Vehicle (real-time communication between vehicles), Vehicle-to-Infrastructure (receive/transmit data about road, traffic, or weather conditions) and Vehicle-to-Everything (a combination of the previous two and focused on enabling general communication between the vehicle and its surroundings) (Chui 2022). A current constraint is balancing the computing workload created by the CoVh between onboard processors, off-board edge computing, and the off-board cloud. The workload allocation depends highly on the use-case-specific requirements such as computing complexity or reaction time due to safety concerns. Over-the-air updates might be delivered over a cloud-datacenter and downloaded through a Wi-Fi connection. Whereas accident prevention workloads (e.g., emergency-braking systems) require high processing speed and low latency and are therefore best processed on-board. With advances in

computing technology and increased connectivity, many new use cases in different areas will emerge. Especially the expansion of 5G mobile networks and the increase in edge computing capabilities will have a significant impact. Through higher reliability and speed as well as the ability to enter up to one million connections per square kilometer, it will pave the way for autonomous driving level 1-4 and the establishment of autonomous driving infrastructure, like teleoperated autonomous vehicle control centers or remote monitoring services. It will enable multiple use cases in infotainment, ranging from infotainment platforms or navigation map enhancements to cloud gaming platforms. A big efficiency increase will be seen through smart traffic control and emergency services, with later especially based on notifications and risk monitoring/recognition. Further opportunities for OEMs include data monetization platforms, the establishment of payment solutions for parking or tolls, improvements in after-market services through remote error examinations and predictive maintenance as well as safety upgrades like theft prevention or dashcam concepts. Besides that, it can also have a positive impact on the electrification of vehicles by optimizing charging infrastructures.

McKinsey (2022) estimates that the combined value of CoVh use cases will increase from $65 billion in 2020 to $450 billion in 2030. This huge value pool will attract, alongside the traditional players, new entrants coming from software development, communication system provision, or hyperscaling. Through the restructuring of the value chains, McKinsey expects two major kinds of CoVh ecosystems to emerge. In closed ecosystems, the group members follow strategically defined standards regarding new technology and end-to-end user experience. Whereas in an open system, which every company can join, the standards emerge through a democratized process, leading to innovation cycles and eventually a common technology stack.

While a deep dive into the impact that connectivity will have on the automotive industry exceeds the scope of this work project, this short overview already illustrated the importance.

It is essential for OEMs, suppliers as well as technology providers to build partnerships to capture the value and be able to cope with the transformation.

5.4 Autonomous driving

5.4.1 Vehicle automation levels and status quo

Autonomous driving is redefining the role of the automobile. It is an essential component of the mobility of the future. Each day cars play key functions in transportation, leisure, etc. Autonomous driving will not only increase safety and convenience but also create more free time that consumers have previously spent driving (Mercedes-Benz Group AG 2022).

Automated or autonomous - these two terms distinguish two development stages in connection with autonomous driving vehicles. Modern assistance and partially automated systems support drivers but do not replace them. In the future, autonomous systems will go one step further: The driver will become a mere passenger (Mercedes-Benz Group AG 2022).

In 2014, SAE International, a professional body for the automotive industry founded by Henry Ford among others, defined six levels of automation for (on-road[1]) vehicles. These act as a guide to standardize the different ranges of vehicle autonomy and were updated together with the International Organization for Standardization (ISO) in 2021, ranging from fully manual to fully automated (SAE International 2021).[2]

Here, Level 0 means that there is no driving automation technology and the driver performs the entire dynamic driving task (DDT), i.e., is fully responsible for controlling the vehicle's movement, including steering, accelerating, braking, parking, and other maneuvers. However, there may also be driver assistance systems that temporarily intervene while driving by using lane departure warnings or blind spot warnings. Almost all cars on the road today belong to this

[1] On-road refers to publicly accessible roadways, including parking areas
[2] See Appendix 1 *SAE levels of driving automation*

category.

In Level 1, a low level of automation is added in the form of lateral or longitudinal control[3] by the automated driving system (ADS). This means, under certain conditions, the car controls either steering or vehicle speed, but not at the same time. Meanwhile, the driver takes over all other aspects of driving and has full responsibility for monitoring the road and must take control if the assistance system fails to respond appropriately. Models that are equipped with this technology are e.g., the 2020 BMW Series 3, and the 2020 Volvo S60 (Krishnakumar 2022).

In Level 2 two the ADS can perform both, the combination of lateral and longitudinal control. In this stage, the driver must monitor the vehicle and traffic and must perform tactical maneuvers, such as responding to traffic signals, changing lanes, and watching for hazards (SAE International 2021). Practical examples are highway driving assistants used in the 2021 Hyundai Palisade and Tesla models with Autopilot (Krishnakumar 2022).

The step from Level 2 (partial driving automation) to Level 3 (conditional driving automation) represents a significant technological improvement, as in Level 3, the ADS conditionally starts taking over the performance of the entire DDT while engaged and within its operational design domain (ODD)[4]. In this stage, the people inside do not need to supervise the technology and can engage in other activities. A human driver however acts as a fallback-ready user and needs to be receptive to a request to intervene and perform the DDT when the ODD limits of the ADS are reached. This means that the driver should take control of the vehicle in extreme conditions (SAE International 2021). Mercedes Benz is one of the leading manufacturers in the development of Level 3 vehicles (Krishnakumar 2022).

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[3] The longitudinal controller is responsible for controlling the vehicle's travel speed, while the lateral controller controls the vehicle's wheels for trajectory tracking.

[4] Operational design domain: a description of the specific operating envelope in which an automated driving system is expected to function properly, including road types, speed range, environmental conditions, and other constraints on the envelope.

In Level 4, the driver becomes a passenger for the first time when the ADS is engaged. No human intervention is required while driving (SAE International 2021). However, the technology is limited to geofencing, meaning the vehicles are restricted to certain areas. Severe weather would also affect these vehicles and likely disrupt their operations. Waymo, Google's autonomous vehicle product, is said to operate at this level. Currently, it is only operating in Phoenix (Krishnakumar 2022).

Level 5 is the highest level of driving automation. At this level, the vehicle can drive itself everywhere and under all conditions without human intervention (SAE International 2021). Currently, there are no real examples of the stage where no human attention or interaction is required.

The Drive Pilot from Mercedes-Benz is the world's first fully certified SAE Level 3 autonomous driving system approved in Germany as an option for the Mercedes-Benz S-Class and EQS models. Passengers may sit back and attend to other matters. However, they must be ready to take control of the vehicle within ten seconds if the Drive Pilot determines that it is encountering conditions outside its ODD. Otherwise, the system will bring the vehicle to a gentle stop while flashing the hazard lights and unlocking the doors.

In Germany, some variants of the S-Class are the first series-production vehicles to offer INTELLIGENT PARK PILOT pre-installation as an optional extra, followed later by the EQS and EQE. The system then enables the driver to drive to and from a reserved parking space - automatically, without anyone being in the vehicle and thus presents an initial version of SAE Level 4. Since November 2022, Mercedes-Benz and Bosch, as co-manufacturers, have held approval from the German Federal Motor Transport Authority (KBA) for the commercial use of the world's first highly automated driverless parking function (Mercedes-Benz Group AG 2022).

5.4.2 Basic requirements and hurdles

While the technology continues to advance to eventually be used for more advanced levels of autonomous driving, regulation is seen as the main bottleneck to the adoption of autonomous driving, according to a recent McKinsey-study (Heineke and Heuss 2021). Germany has recently introduced regulations and particularly strict guidelines on autonomous driving. The new Act on Automated Driving has created the regulatory framework for autonomous motor vehicles (Level 4) to be allowed to operate in regular public road traffic in defined operational areas - throughout Germany (Federal Ministry for Digital and Transport 2021). Various regulations have also emerged at the municipal level in China. However, many other countries lack comprehensive regulations (Heineke and Heuss 2021).

Another factor is consumer demand for autonomous driving. In a survey, the &Audi initiative (2019) analyzed people's willingness to embrace autonomous driving as a function of sociodemographics. The initiative found that across national boundaries, Generation Z is particularly open to autonomous driving. Men, well-educated people, and people with higher incomes are also more positive about autonomous driving (&Audi 2019). When it comes to individuals' trust in the technology, a Capgemini study states that consumers trust automotive OEMs over new startups (Winkler et al. 2019). This is attributed to the pre-existing bond between incumbents and their customers.

However, consumers are skeptical about certain aspects of the self-driving car. Almost 75% are concerned about safety and security. Another concern is hacker attacks. In one experiment, researchers managed to remotely manipulate and eventually destroy a Jeep during a demonstration (Greenberg 2021). A Deloitte study underscores that the way forward should include a comprehensive approach to cybersecurity to make sure connected vehicles and their associated ecosystems are secure, vigilant, and resilient. The study also expresses hope that many of the cyber risks that the future of mobility will bring have already been addressed, and

that the advanced automotive industry can stay one step ahead of hackers and other adversaries by taking hard-won lessons from other industries (Nash et al. 2017).

All in all, the diversity of innovation in the automotive industry today is immense. Trends and technologies are developing as cross-cutting issues that encompass various dimensions such as drive technology, sustainability, and digitization. They no longer relate to the car at the core, but to all of a company's value-creation activities. This makes it all the more important for companies in the automotive industry to network and expands their hubs to address these cross-cutting issues.

6. Business ecosystems and open innovation

6.1 Closed versus open innovation

The logic that was taken for granted in the previously prevailing paradigm of closed innovation was that if a company wants to do something right, it has to do it itself (Chesbrough 2003). In contrast to that model, an increasing number of companies discovered open innovation as a collaborative paradigm coined by Henry W. Chesbrough in 2003 to renew their innovation strategy and increase their innovative output. It is no longer just internal knowledge and technology that determine a company's performance. Instead, they need to adhere to external resources by building linkages with external parties through collaboration and connectivity (Gassmann 2006). The collaboration can refer to horizontal linkages (i.e., competitors), forward linkages (i.e., customers), backward linkages (i.e., suppliers and consultants), or public linkages (i.e., universities) (Roper, Du and Love 2008). In the literature, the possibilities of cooperation with external parties are often divided into two dimensions: outside-in and inside-out.

In an outside-in model of open innovation, a company looks outside its organization for support for its innovation initiatives. The company benefits from external innovation as it allows for more thorough exploration than it would be possible if the company solely relied on its

resources. (Grimaldi and Grandi 2005).

The inside-out open innovation approach, on the other hand, helps to establish the use of a corporation's technical platform by other businesses. By positioning itself as a platform leader, a large corporation can take profit from every innovation that is sold on the platform. OEMs in the automotive industry also see open innovation as an opportunity. Jasmin Eichler, Director of Future Technologies at Mercedes-Benz sees "open innovation [as] an important lever in today's very dynamic market environment" (Eichler n.d., n.p.). With the innovation platform STARTUP AUTOBAHN, Mercedes-Benz as a founder mediates between startups and large corporations. According to Eichler (n.d., n.p.), the goal is to "constantly [look] for disruptive innovations and new approaches for the further development of mobility and sustainability areas [and to] combine the founding spirit with comprehensive automotive expertise to help shape the future of mobility".

6.2 Cross-industry partnerships

OEMs originally outsourced large parts of development work to suppliers as part of traditional contractual relationships. This is a viable option when dealing with known technologies that can be partitioned with clear interfaces. However, this changes for innovations and new technologies. For example, the development of autonomous driving technology is one of the most complex in the automotive industry. The wide range of abilities and skills needed to complete this task, is rarely found in a single player among traditional OEMs, suppliers and technology companies. OEMs often have difficulties adopting new agile product and software development systems, while technology companies are well positioned in these areas. The latter, in turn, lack experience in industrializing and scaling a hardware business, like that of car manufacturing (Proff, Pottebaum and Wolf 2019).

Therefore, companies are joining forces in development partnerships. Cross-industry

partnerships are a necessary prerequisite for addressing these complex challenges and closing an OEM's own technology gaps. In the development of technologies for autonomous driving, for example, stakeholders work together or enter into partnerships. Mercedes-Benz as an OEM for example works together with Nvidia as a technology firm and Car2Go, mytaxi and Uber as mobility providers. As described in the section on autonomous driving, the OEM also partners with Bosch as a supplier. But also, between Mercedes-Benz and BMW exists a partnership (Proff, Pottebaum and Wolf 2019).

6.3 Business ecosystems

With globalization and increased global connectivity leading to a connected world, the use of a network can lead to market dominance (Burns 2020). Amazon and Google, one of the fastest-growing companies today, are positioning themselves as ecosystem players. They have developed a new competitive advantage by working together as ecosystem orchestrators in networks (Birkinshaw 2019).

In contrast to simpler cooperative arrangements between two parties, ecosystems involve a complex constellation of actors (Heineke, Hornik et al. 2021). In an ecosystem business model, all involved players need to be actively involved which demarcates it from a strategic delivery network. Consumers typically do not know where a car manufacturer sources its brakes, as they were provided through the strategic supply network of the manufacturer. However, if there is e.g., Apple CarPlay available in a BMW, consumers are recognizing the collective value of member brands. Hence, business ecosystems exist to create a higher level of value collectively than the members can create individually. The members of a business ecosystem sell collaboratively to common customers. It requires one or more members to act as an orchestrator responsible for the structure and performance of the business ecosystem (Sarafin 2021).

Mobility ecosystems are formed around consumer needs by creating additional service layers

between OEMs and users. Within these ecosystems, they offer interconnected products, services or solutions that meet a variety of customer needs. The companies involved have data sovereignty and access to the key information needed to create an integrated solution and a convenient customer journey (Heineke, Hornik et al. 2021). They also gain access to complementary capabilities necessary to create a superior product and cover their blind spots (Proff, Pottebaum and Wolf 2019). Ecosystems, therefore, provide economic incentives and benefits to all stakeholders involved, representing a variety of industries and stakeholders with complementary capabilities and a common goal. Joint R&D investments reduce risk and accelerate development in pursuit of key trends. OEMs that fall into the traditional player category benefit from ecosystems because they gain access to new customers and new technology-driven innovations. Ecosystems also enable supplier consolidation, leading to scale and increased performance (Heineke, Hornik et al. 2021).

Yet despite the fundamental challenges on the horizon, most automakers are reluctant to open up to outside innovation dynamics and thus to new partners. Emission-free powertrains and computer-controlled driving are only a small part of the widely anticipated future scenarios, the development of which will require a gigantic amount of coordinated development, networked innovation, and inventiveness. The collection of German automotive inventions and patents indicates a high level of expertise that will continue to play a role tomorrow. However, there is a need to catch up in the integration of non-plant technologies, which will play a major role in the digital age. This is only possible by opening up the strictly closed ecosystems of the automotive industry, which is increasingly interfering with other sectors. Internet, telecommunications, hardware, multimedia, as well as navigation providers, and other industry newcomers such as Apple and Google are entering the market. The value chains and the market will reinvent themselves, and the stealthy compartmentalization will give way to open, scalable

infrastructure platforms and modern APIs. Tomorrow's customer also expects systems to open up, multilateral connectivity and compatibility, and a seamless experience enabled by automatic connectivity and synchronization across all communications and other devices, regardless of the manufacturer (Harting and Proff n.d.).

7. Changing customer preferences

During the Covid-19 pandemic, consumers changed their consumption habits driven by a change in their behaviors. Supported by the evolution of technology, people started to use digital platforms more heavily to purchase daily products or clothes, leading to new expectations of brand interactions. This happened because of imposed quarantines in many countries leading to a majority of people staying at home. After Covid-19 passed its critical phase and we reached the present, the new consumption habits remained and lead to the necessity that brands need to reinforce their whole digital experience.

Likewise, the automotive industry has undergone this change and adapted accordingly, for the most accelerated transition to new technologies as a means of interaction and purchase, running a huge digital transformation (Charm et al. 2020). In 2022, Deloitte conducted a study of the automotive industry to describe what trends consumers would follow in the coming years, concluding that four are standing out: customers still want to pay little for more innovation, representing a limited willingness to pay; there is more interest in electric vehicles, mainly because they represent less cost in use; although there is an overwhelming growth of digital experiences, there are still many people who prefer in-person experiences; and to finalize, customers still continue to prefer the car as the best mean of travel around (Bowman and Proff, Deloitte 2022). Still on electric mobility, mainly the new generations are more concerned with environmental issues, hence the purchase of electric vehicles is a positive trend that is likely to increase in the future. For example, in Germany, according to the same Deloitte study, 43% of

consumers who intend to buy a car in the next three years are considering an electric one, being the eighth country in this rating (Bowman and Proff, Deloitte 2022). The online experience is revolutionizing the market, all information related to the various options in the market is easily accessible to all potential customers, including reviews and opinions of other users that can influence decision-making. OEMs need to follow the change in people's mentality, who want a more connected and immersive experience. According to research done by PwC, by 2030 more than one in three kilometers traveled will be done involving a shared mobility solution. Citing also that the new generation of drivers is changing the mentality from ownership to drive experience, avoiding the car as a means of personal transport, and privileging it as a group-based mobility solution or as a subscription or rental service. Millennials are becoming the new car buyers in the future, and dealerships have to adapt their traditional ways of selling cars. The new adaptions must meet new ways of thinking, as new generations are used to instant online reward behavior, so new methods are needed to achieve this gratification faster and without long waiting times (Shah 2022). In 2022, prospective car buyers spent an average of seven months researching online car and brand options, whereas in 2017 that number was just 2.7 months, showing once again the shift to online media as the best means of review and search (Andersen 2022). In this sense, new potential customers are more demanding. Jessica Stafford, head of Autotrader and Kelly Blue Book said that if OEMs do not give all information to customers or don't answer their questions on chats, emails, and phone calls, they will give up purchasing with that OEM (Andersen 2022). Therefore, OEMs must keep up with the changing beliefs, making the experience even more enjoyable for the consumer to ultimately retain them.

8. Customer preferences for their journey into the future of the automotive industry (Francisco Coelho Martins, 39571)

8.1 Introduction

Sam Walton, once said, “There is only one boss. The customer.” The center of any industry is the person who buys the product, and everything else is created around them according to their preferences and needs. Consumers, being the center of attention for all development, want to feel accompanied, cared for and most importantly, they want to feel that they are the number one priority for any OEM, not just another source of revenue but the most important part of the industry's journey. Selling a product is not just a trivial transaction, but a moment that can stay in the consumer's memory and can be memorable for them, hence OEMs should not just want to sell but advise and warn potential buyers about everything, creating a relationship between both, which will facilitate the emergence of a more lasting and stronger relationship.

8.2 Methodology

In this individual part a survey was developed and ran to check the facts and opinions of various writers and professionals of the industry we had from the literature review, and to create new insights on the themes, exploring this individual topic with more depth and studying other source of new information, targeting the German market. As the general topic is studying the automotive industry in Germany, especially the innovation on the future, the survey was shared so that as many responses as possible came from younger age Germans, to find out what young people want from the industry for their future. Indeed, the average age of the respondents was 23 years old. The survey consisted of 27 questions in total, although only some will be used for the study because they are the most important and there is no consistency in the number of respondents in the various answers.

8.3 Customer Journey

8.3.1 How customer enter in the current ecosystem is the beginning of the customer journey

The automotive industry used to focus on the engineering around the car, with specifications

and features being the key parts of the equation which was based on product quality and benefits. Nowadays, the consumer has become the focus in the industry, with the consumer experience being what differentiates between different OEMs. The customer journey starts when a person has the intention to buy a vehicle, if in the past the journey started when the customer arrived at the dealership, nowadays it starts when the person is at home searching for several options online. Brands that want to succeed in the current times need to enter the equation when the person is still just a potential buyer searching for different vehicles, brands and specifications. Consumers are changing their habits, and with the rise of new technologies as new means of communication, people interact with brands very early in the process, so it is important for automotive OEMs to be able to start the experience with the possible consumer as earlier as possible, to captivate a greater number of potential customers and not let them slip away to competitors.

8.3.2 Customer Journey in the present

The customer journey of a typically first purchase has five phases initially, with a sixth phase that depends on customer satisfaction in the long term. As previously discussed, the first stage is the person looking for different options, using mostly the online tools available, thanks to technological innovation. It is based on the information available, and the way brands show their products and communicate with their targets, even if as an indirect touchpoint as they do not communicate directly with each other. In a second phase, the potential customer contacts the dealership for more information, considered the first direct interaction between the two, the brand can capture the consumer right away, creating a comfortable environment for him, offering him a test drive to better convince his decision or show more characteristics and advantages of their cars. Then comes the decision and negotiation phase, where after seeing various options and brands, the customer chooses the one that best suits his expectations and like the most. Here it´s the crucial phase that marks the split between the search phase and the

beginning of the connection with a specific OEM brand. The whole process of negotiation, financial consideration and signing of the contract takes place during this phase. With the customer captured and the deal done, it is important to maintain communication with the customer, giving updates on delivery dates or distribution phases, thus keeping the customer up to date with the latest information and making him satisfied with the service provided by the brand. After the car is delivered the fifth phase begins, where the brand need to remain close to the consumer by providing solutions to possible software and mechanical problems that appear, or through services such as subscription services that create a continuous interaction between brand and customer. The brand has an important role in promoting a sustainable relationship between both, creating a favorable path for the last stage of the customer journey, repurchase, which is more likely in the long term when the customer comes back to buy another car.

8.4 Aftersales

Aftersales has always been considered a minority stage on the journey. However, over time, it has been considered much more important and relevant and it is now imperative to improve this service as it represents a large slice of the business, in monetary terms but also to maintain good customer loyalty and relationship (Modera 2021). Aftersales is not just about getting solutions to car problems, book and do maintenance or having a subscription service, it also includes consistent communication between the brand and the customer, seen as a great opportunity to create a huge and strong relationship between both, creating more customer retention and satisfaction, which can translate into higher revenues, because a happy customer will speak well of the brand, word-of-mouth is a strong tool to take advantage.

8.4.1 OEMs need to adapt

It is more difficult for OEMs to be competitive in the market, because small changes are not the big difference, anymore. To stay in the lead, they need to invest heavily in new technologies

and innovative experiences for the customer. As stated previously, OEMs rely heavily on after sales to create touchpoints with customers. As technology advances, the biggest touchpoint with the customers does not happen with dealerships, as there is not as much need for overhauls and fixes, but it happens at the technology level. Customers are increasingly demanding technology and new features that provide them with new experiences (Penthin n.d.).

8.4.2 New innovations from OEMs

OEMs have rushed into some decisions, such as creating better repair, maintenance and comprehensive service in several areas and introducing new ownership models like leasing and carsharing, also create innovative ways to gain customer retention and increase their revenues (Singh Sidhu and Shetty 2022). For example, Porsche has created a system in which it sends its customers videos with data and footages on the production actual status of their new vehicle, when being built. This video works as a means of communicating to the customer the new options that they can add, and also as a touchpoint between both parties, where the buyer can accept or decline certain features for the new car. Also, Porsche, launched a passport, where customers pay a fix fee per month and can use up to 22 cars of the brand according with their desires or needs, like a renting but as a subscription (Shah 2022). The case of BMW that has a subscription service, in which the customer pays a monthly fee to have heated seats in the vehicle, without paying the subscription this feature is not available although it is installed in the car (Neto, pplware 2022). Also, Mercedes-Benz has recently launched a subscription service for some of its electric cars, where the user pays a monthly/annual subscription. When activated, the car will increase the power by about 20%, also increasing the starting power. Again, the functionality is already present in the car, but is only activated by paying the subscription (Maria 2022). Mercedes' announcement is the latest bet on a phenomenon that has been growing in the automotive industry, the bet on the so-called “on demand” services, with a view to increasing and diversifying income sources (Maria 2022). IoT is also an essential tool

that allows real time access to a vast amount of important data about the functioning of the car, passing this information to the driver as alerts, diagnostics, improving driving efficiency. For example, a German OEM has equipped its vehicles with AI in the cockpit, which is controlled by voice, allowing users to access in-car systems such as media, navigation, GPS, and other functions that enhance the driver's experience of the vehicle (Singh Sidhu and Shetty 2022).

8.5 How customers feel about their journey

From the aftersales support, customers are expecting a personalized and individual approach, with great assistance till the end of the car's life. A study carried out in the German market revealed that the owner of a quality car brand wants customer service to match, but in reality, is not happening, which causes concern for the car OEM brands. According to this article (snapcell 2021), the most important speak is that OEMs never should mislead any customer, to not reduce the business levels and maintain reputation.

8.5.1 Priorities and poor connection

According to research conducted by Accenture, there is a gap between consumer and OEM priorities, while consumers care about issues such as repairs and maintenance in aftersales, OEMs care about more general issues such as the environment. According to a survey developed by McKinsey & Company, 39% of customers believe that own car brand is not prepared to deliver a good customer experience, and 46% would change for other car brand if deliver a better experience, besides that if one OEM fail delivering some type of service, 47% of people, consider changing their OEM. Consumers are thus related to one brand, but if there is a chance that they are not because they feel underestimated, they will switch to another.

8.5.2 Sentimental connection

One advantage over competitors is to establish a good and strong relationship with customers. OEMs always try to create campaigns where they show and internalize that relationship. For

example, BMW created environmental protection measures to show their position regarding carbon emissions and to become a fully sustainable company in the near future, bringing their relationship closer to like-minded customers who support environmental causes (Shah 2022).

8.5.3 Rational connection

This phase appears mostly between the will of wanting a new car and the act of acquiring it, in this period the consumers is very rational to measure the various options and is where the brand establishes various relationships with the possible buyers and must persuade with a strong message to help the purchase (Shah 2022).

8.5.4 *Customers are not completely happy* with OEM services

In the case of the subscription services of BMW and Mercedes-Benz, the customers didn't like the idea very much. In BMW's case there was no official announcement because, in 2020, when they launched a similar service that relied on a microtransaction, customers found that move greedy (Neto, Pplware 2022).

8.6 New generation is changing the future customer journey

New consumers and new generations are adopting new behaviors and consumption habits. As this work is more related to young people and the German market, it is important to study this target group of the market. So, let´s consider Germans with ages between 18 and 34 years old for the next observations stated below. According to a study by Deloitte (Bowman and Proff, Deloitte 2022), this group prefers a petrol/diesel vehicle as their next car, however 38% prefer a fully electric or hybrid vehicle, with 12% preferring a fully electric vehicle. The switch to electric vehicles contains some fears by the part of young people hence there is not a higher percentage for the switch. Among the greatest fears are the driving range of the vehicle, which is usually smaller than a fossil-fuel vehicle, the cost of the car, which is still relatively expensive, and a whole range of fears related to the batteries, from charging time, charging

infrastructure, and fear of loss of value. These young people expect the cars to reach 680 kilometers, to be considered as a good option, there are still few cars that can do it. New technologies allow for new ways of buying cars, and as we talked about before, a lot of literature talks about young people betting more on this aspect and preferring the use of technology when buying cars and customizing them, but this study is not so consistent in that sense. In fact, only 6% of the group in analysis want to acquire the next vehicle in a completely virtual process and 28% want a partially virtual process. On the other hand, 64% prefer a complete process in person, physically with the seller, going against the beliefs of some writers previously mentioned, showing that although the new technologies are the future, they are still not 100% preferred, and the large percentage of people who prefer a process with something in person, prefer it because they want to see the vehicle first, test drive it and even negotiate in person with the seller, also creating a physical relationship with him. On the other hand, digital methods also have their advantages, such as convenience, the speed of the process and ease of use, but these are not enough to allow the consumer to make the entire decision, at least, nowadays. (Bowman and Proff, Deloitte 2022) The next generations have a favorable point for the OEMs' interests, the brands/manufacturers of the cars are the providers that consumers trust the most with a percentage of 31% over the others, which is positive because it can lead to the growth and maturation of the OEMs' position in the market and in the consumers' minds.

8.7 How customers can be captivated to enter in the future ecosystem

According to Chadha and Dr.Sardar, tomorrow's customers want a car as a life experience or lifestyle symbol. A customer journey connected with the brand on multiple points, an integrated, cohesive, intelligent and personalised experience (Chadha and Dr.Sardar 2021). A good way to captivate the customer and create an enjoyable experience is to focus on peak and critical moments of the customer journey, specific moments that cause more impact on the

customer, such as when the customer comes to the dealership and sees his new car for the first time, OEM can create here a pleasant experience (Charm et al. 2020).

8.7.1 Database is everything

An essential part of the customer journey is the collection of customer data, whether at an earlier or later stage of the process. Newer cars with internet access collect around 25GB of data per hour, such as the location or even weight of passengers (Meyer 2022). By having access to so much customer information, the brand can provide the right choice at the precise moment when it is needed. In the case of a periodic service, the brand can send a reminder when that date is near, with days available for the service, preventing the customer from going to another workshop (Modera 2021). It is important to explore new ways of getting information from customers across boundaries. For example, a car can be connected to the digital system that manages the equipment at home. In the absence of groceries, the information is transmitted to the car which will suggest a supermarket to the driver and warn him of the need to buy these products, this is only possible with an integrated database system between car and home. Data is the most important tool for improvement. The ideal is a combination of dealership data, such as demographics, interests, and budgets, in conjunction with on-board computers, which provide information about certain patterns of vehicle users, and also marketing data, that is more related to interactions from various channels and better methods to deliver the news. With these three aspects it is possible to improve after sales service in several ways (XMPie n.d.). OEMs can then use the vast amount of information they have collected to better monitor and plan a better experience, based on each customer and their car, offering appropriate services for each one (Shah 2022).

8.7.2 Customer intimacy

According to Dr. Stefan Penthin customer intimacy is the key for the industry. It is important to maintain a high and positive customer intimacy. OEMs should use as much information about

their customers as possible to improve their customer interaction solutions and create new revenue streams, always keeping the customer in mind. According to a study, If OEMs don't deliver a good service across all channels, 46% people said that they would switch for a different brand if the customer journey were better (Andersen 2022). About creating an affectionate relationship where the customer sees the OEM not only as the brand of his car, but as an entity that is available for all his doubts and problems. OEMs must show the opinion of other customers and testimonials, to confirm the quality of the services provided. In this sense a good solution is to have a well-trained and friendly staff.

8.7.3 Multi-channel marketing platform

The traditional style of marketing has been overtaken over time with new, more effective, and comprehensive methods. With digital, the number of potential touchpoints has also increased, but this does not mean that the entire strategy must be digital, the most important thing is to be interconnected and coherent to deliver a clean and concise message, thus improving the customer experience (Andersen 2022).

8.7.4 Streamline the process

It is essential to reduce the number of people who interact with the customer, so that the customer takes less time during the whole buying process, but clarifying anyway all doubts and curiosities, which will make the customer more satisfied.

8.7.5 Calls

Calls are a very important part of the process when a customer is looking for or already has a car. That is why it is strongly advisable to have a system that connects you to the closest assistant or a system that before connecting both recognizes the problem of the customer, through some inputs given by the customer, and transfers it to the best expert assistant. In this way, the client will be happier because his doubts will be clarified quickly (Andersen 2022).

8.7.6 Car sharing

One of the main changes that customers are adopting is the idea of car sharing. This phenomenon has experienced an exponential growth in the most recent years and could turn into one of the strongest pillars of the automotive industry in the coming years. It will bring negative aspects in OEM sales decreasing, and greater competitiveness between OEMs and companies developing this service, but what we have seen and will be the future, is the partnership of the brands themselves with others and with companies in the sector to create their own car sharing system and meet the needs of the current and future users. With the implementation of this model, the benefits will be environmental, noise reduction and less pressure on infrastructures (Shah 2022). In the future, new ownership models will gain more importance and OEMs should use blockchain technologies combined with IoT technology to facilitate the creation of an easier and more useful carsharing system (Singh Sidhu and Shetty 2022).

8.7.7 Virtual experience

With increasing digitalization, the first experience with the vehicle is also more virtual. Studies show that from 2018 to 2025, the use of AR/VR technology in the automotive industry will increase by 175.7%. OEMs must invest heavily in this aspect, providing immersive experiences, with 3D models of their cars with the desired configurations, providing an online showroom experience with a virtual test drive (Singh Sidhu and Shetty 2022).

8.8 Survey

As previously mentioned, a survey was carried out to confirm or corroborate existing information about the automotive industry. Remembering that the survey was assigned to achieve a coherent sample of the young German population, who already own a car or not, either individually or in their household, exploring the potential users and buyers of the German

car industry of the future. For best results, the answers will be explored one by one, and some individual conclusions drawn, because in all the questions the number of answers may vary. All results are presented in Appendix 2.

8.8.1 Customer Journey satisfaction aftersales

The first question of the survey addresses the overall satisfaction of customers or customers' relatives when buying their latest car, available in the appendix 2.1, it has analyzed the global customer satisfaction journey across five key parameters: customer support, subscription models, brand mechanical support, quality of materials and software updates. In the five categories, was obtained an average always above 3, corresponding to all parameters showing a non-negative quality. Considering the respondents as a sample of the German market, the customers are currently reasonably satisfied with all services in general, although the ratings are not negative, they are not perfect either. In a general analysis, the consumers who responded to the survey are more satisfied with the quality of the materials in their cars, with an average rating of 4.24 points, this quality stands out from the other categories. Meaning, that among everything that involves the consumer journey, the quality of car materials is satisfying them. In the other side, the service with the greatest dissatisfaction is the subscription service, in line with what was stated before, that customers do not like this service in their cars, because this service is a novelty, and people are not very much in favor of changes of this nature. This confirms the great dissatisfaction of users with this service. Based on these results, the car market will have to improve its support to car owners, whether in mechanical or theoretical terms, respondents feel that this support given by brands is not very good, being only reasonable and perhaps insufficient in some cases, especially aftersales, which can prevent the appearance of the sixth phase. Also, software upgrades show a reasonable result, because the new generations are much more internalized in the new technologies, so it is an important aspect that is not being developed in the best possible way by the OEMs.

8.8.2 Subscription models

Previously, the case of BMW and Mercedes-Benz subscription services was shown and in this sense one of the topics of the survey was about these services. In the first part people were asked if they would consider subscribing and using such a service in their car, as can be seen in the appendix 2.2 and its sub-categories. In the appendix 2.2.1, with one hundred and sixteen answers to this question and an average of 2.95 points, in a scale from definitely not consider to definitely yes consider, there is some indecision among the answers, not least because with a standard deviation of 1.24, not all are on the same track, because it is visible a great dispersion in the answers. As it is a new service in the automobile industry, many are still unfamiliar with it, and young people who are more used to these services on other platforms, also show some fear, as there is no standard of response but rather a lack of definition as to whether they would subscribe or not. Although the texts on this subject show some dissatisfaction on the part of the users, the conclusion reached with this question and in conjunction with the previous one is that the service may work for this new generation, as long as the negative aspects that may still exist are improved. In the next part, appendix 2.2.2, it was asked what services should be made available for these subscriptions. Of all the features presented, online entertainment access was the most voted for, as young people are already used to having a subscription for these types of services such as Spotify or Netflix. For more mechanical features related to the car, such as seat heating or cruise control, the vote was lower, as these types of features are usually already included in the car, so there is no perception that they can come into this type of system, thus confirming the distaste that already exists around these features. It was already shown that safety is a very important factor for users, and it is once again highlighted, because the feature voted less to enter the subscription service, was the automatic emergency breaking, is a feature related to safety, which should be installed in all cars so it should not be necessary to pay more to get it, is this the thinking of the group under analysis. Willingness to pay for three different

services was also asked, appendix 2.2.3 – 2.2.5, if they were on the subscription method. For heated seats, users are willing to pay around €21 per month on average, for driving assistance/crisis control they are willing to pay €31 per month on average and for Automatic Emergency Breaking they are willing to pay €33 per month on average. Comparing the three, the devices related to user safety have a higher value, as users are willing to spend more money for their safety, as previously mentioned, safety is a fundamental factor, and while they do not want the service as a subscription service, if brands do, they are willing to pay more for security reasons. Thus, showing some inconsistency in the answers, but that brands can take advantage of as a source of higher revenue. Heated seats, on the other hand, are a comfort factor, which consumers are no longer interested in purchasing at higher prices and are considered a second-rate concern.

8.8.3 Uses of data

An important growth aspect across all industries and also in automotive, is the increasing use of consumer data, seen as an important factor in the future for maximizing customer satisfaction and improving the customer and business journey. But to what extent do consumers agree to give their information to companies to improve their experiences? In the survey, appendix 2.3, were created three distinct situations to understand in each one whether consumers were willing to give their data. The first situation, appendix 2.3.1, is whether car owners authorize OEMs to capture and analyze all the data, for use in future technology improvement. About 66% of the answers were positive (somewhat agree and strongly agree), showing that the use of information for reasons of technological improvements is well accepted among the users, going along with previous themes that stated that the new generations are more concerned with technological and innovation issues.

The second situation, appendix 2.3.2, was about the use of people's data for issues related to user security, in which about 75% responded positively (somewhat agree and strongly agree),

also showing that the individual security of each one is a very relevant factor, being able to give up a certain degree of confidentiality of their data to help the development in this field. In fact, user safety has always been a very important aspect of the automotive industry, and users of the future seem to be aware that it will continue to be.

In the third aspect, appendix 2.3.3, they were asked whether they agreed to make it available for customized marketing uses in the future. With an average of negative responses, meaning that most people do not agree in any way with this use, almost 53%.

Being that data as important as described in the section about databases, it is necessary for OEMs to define well why and what data they are collecting from users in their cars, because not all information collection is consensual. So, since databases are so important for the future of the industry, their users know this too, and are willing to collaborate on technical aspects, security, and development. However, as approached earlier about collecting data on various aspects of the car user's life, this may not be the best way to create a good journey, as people tend to protect their information and do not want it available to third parties, especially for commercial purposes.

8.8.4 Users prefer third-party services

In the appendix 2.4, it was asked if users preferred third-party services, like google maps, or services from the OEM itself. The results were clear in showing that almost 60% prefer to have third-party services. This is an important aspect for OEMs because their features are being considered as inferior, not the preference of users. This aspect is relevant, in the sense that for example the new generation may prefer to use google maps, because they can have access to the same system in the car, on the mobile phone and on the computer, all on the same account, while when using the OEM's systems, they can only use it on the car's onboard computer. This is where the trend towards interconnection between platforms appears in order to make it easier to use and more appealing to the end user. This is a point that OEMs must correct and even

make partnerships with companies that already have large applications, for example in this case with Google, to provide the service in the car.

8.8.5 Circularity is important for next generations

In another question it was asked whether circularity was important in the decision of buying a new car, appendix 2.5. With an average of 3.31 points, it has some relevance in the choice. The users of the future are concerned with environmental issues, in the sense that reusability is seen as a factor to be taken into account when choosing a car and its brand. That's why brands also advertise to show their position on environmental sustainability, to connect with customers' ideals.

8.8.6 Customer preferences and desires for the industry in the future

To conclude the topics and ideas of the survey, it was asked, appendix 2.6, what each person would value more when buying a car in the future. In the first place, the quality of the car stands out as being the most important factor for young people, but with a minimal difference to the second place, which is safety, going along with all the other questions, where this topic has been explored a lot. As a less important factor, the customer support after sales stands out, which is surprising because it goes against the idea that to create a good customer journey, it is necessary a good support from the OEM, intensified in the aftersales period.

8.9 Limitations and Further Research

This study, through the survey, shows some limitations, starting with the number of respondents, who were few in relation to the total population, however it gave a deeper and different point of view of the ideas already existing. One limitation that the survey also has is that it only covers the younger population, so we are left with an analysis only for this group and their beliefs about the future, and we have no idea what the older generation wants the future to be like and what their ideals are. The current generation are also the consumers of

tomorrow, so it is necessary to know in a future analysis what they want for the automobile market. For future analysis, it is suggested to carry out a similar survey, but covering a higher number of respondents, and divide several analysis groups according to their ages, to give a more realistic idea of the market situation for the future. In general, the study analyzes consumer preferences and how they feel in the current journey, however it is not explored in depth for each individual feature, which should be done in the future to know the reaction of consumers to each new feature of different brands to also get a sense of how users react to each feature and each brand, to help OEMs better know the reaction to their products.

8.10 Conclusion

With a first analysis of the existing literature, it was possible to define the customer journey and its six stages, highlighting the importance of a good relationship between OEM and customer, to reach the last stage of the journey and full satisfaction. The biggest difference to the past was the bet on aftersales, with innovative services that allowed maintaining a good relationship with the consumer, betting heavily on the creation of new touchpoints with consumers. With the recession in the market, OEMs needed to reinvent themselves and offer new innovations. With several changes that existed in the market and in the companies, the users also tried to adapt to the changes, but they did not always react in a positive way, as in the case of the subscriptions. However, OEMs have always tried to get closer to their users' ideals, promoting sustainability, and creating sentimental and rational connections, to capture more of their attention and reach more people. Although there are already changes in the current market, it is important to note that the newest generation is different in many aspects and will further influence the automotive market situation in the future, hence being presented the great ideals of this generation for the German market in the future. These include the adoption of electric cars, although not as much as expected, and the surprise of wanting to make the

customer journey physically and not virtually as expected. For this new future market, it is necessary to create methods to captivate the largest number of customers, largely through the high use of users' data, which can be captured not only in their cars but in all aspects of their lives, to create even better services and innovative functionalities. Creating maximum customer intimacy and streamlining the process before and after the sale to make life easier for buyers, meeting their needs and beliefs. With the survey it was possible to draw some conclusions about the existing materials. In fact, the subscription services are the worst innovation that has appeared in the automobile industry, more for the current, but also for the future generation. The use of consumer data was also confirmed as being important but for safety and innovation purposes, excluding marketing from the equation. On the other hand, there is a contradiction, if the new generation trusts OEMs, the survey showed that they prefer third-party services, but are aligned with sustainability values, just like OEMs. As the final survey and literature remarks for the future, the consumers of the future place great value on the quality of car materials, car safety, technological innovations, customer intimacy, clear journey, car sharing and virtual reality. They show that OEM support is not a key aspect for them, maybe because at this moment that support is not the best and they have no expectations for the future. This is where OEMs must invest to maintain their leadership position and to deliver a good experience.

Group part – Automotive Innovation

12. Overall conclusion and recommendations

This work project examines the automotive industry for its innovation characteristics. Disruptive trends dominating the automotive industry are driving unprecedented change. One can be found in the fundamental change at the OEMs themselves, which are increasingly shifting their focus from hardware to software-driven innovation. Another aspect of this study presents the need for companies to open to the outside world and collaborate in partnerships and business ecosystems, as the required actions can no longer be shouldered by OEMs alone and the multi-layered requirements demand capabilities beyond those of OEMs. In other words, changing external conditions, such as industry competition arising from the threat of new entrants, supplier and customer power, and more stringent regulations. are putting pressure on automakers to innovate and evolve with the changing times.

Four individual deep dives shed light on the challenges faced by German premium OEMs in the automotive industry from external and internal perspectives. They examine how established automakers can maintain their competitive position and continue to present themselves as innovation leaders.

The first perspective focuses on the consumer, who is a relevant driver of major changes within OEMs' strategies and their product portfolios. Based on the combination of secondary and primary data, a changing society is reflected for example in the fact that tomorrow´s customers, Gen Z, are more likely to value technology and innovation. Yet, they still demand the physical experience at the retailer. The study also reveals the importance of exploiting data to deliver an enhanced customer experience as well as the customer's willingness to share information when it is used for innovations in the field of safety and comfort. In addition, there are currently services not meeting users' expectations, such as subscription models which enable additional

features. Using the data collected from the survey and secondary data, this study draws the conclusion that although the new generation is more technological- and digital-affine, the priorities also encompass user safety, car quality, environmental sustainability, and electric mobility. As a result, OEMs have to consider new customer preferences and adapt their main touchpoints to deliver the most satisfying customer journey possible, also taking into account the future generation of customers.

Further, following a shareholder's perspective, the capability acquisition through (alternative) M&A is analyzed as a possibility for an OEM to respond to the pressure of keeping up with technological change. It describes partnerships, strategic alliances, and normal M&A as appropriate tools. As investors carry the indirect costs and allocate financial capital their view on announcements of such deals is of great interest. This deep dive examines three hypotheses: In the first hypothesis, it is assumed that the market rewards announcements of such deals. The second one is about the market rewarding CASE technology deals more than other deals. Finally, the third hypothesis assumes that recent deals are rewarded more compared to deal announcements in the past. The suggested event study with a regression analysis aims at finding out if there is a significant abnormal return following the announcement. From this, it is expected that all 3 explanatory variables (announcement, CASE-tech, recent announcement) have a significant effect on the abnormal return. This study fills a research gap in the academia on event studies in the automotive industry. It is important for firms to know what kind of deals get rewarded to maximize shareholder value. Firms can adapt their M&A strategies and innovation efforts accordingly. Investment funds and individual investors can optimize their stock selection and consequently, this provides insights if (alternative) M&A deals are really an accepted (by investors) tool for capability/tech acquisition and innovation.

The third study presents an internal perspective on how an OEM needs to adapt its organizational structure to be innovative. It puts emphasis on the need for established OEMs to

incorporate organizational ambidexterity by exploiting existing capabilities and at the same time exploring the needs of tomorrow's customers. OEMs are advised to tackle this challenge with the help of organizational separation as a form of corporate venturing. A practical case is used to analyze the contribution to overall innovation within an organization through a tech subsidiary as a possible form of a separate entity. It demonstrates that a successful combination of the advantages of an established organization with those of smaller ventures and achieving a valuable innovation contribution depends on the innovative strength of the dedicated separate unit. This in turn is linked to framework conditions such as an adequately balanced innovation portfolio within the separate entity that covers different types of innovations. To achieve the latter, the entity needs to pursue different approaches and implement appropriate processes internally. What is more, a collaborative and integrated partnership between the parent organization and the subsidiary is required.

The last study of this work project presents the pressure on German automotive OEMs to incorporate CE arising from more stringent regulations and self-imposed goals of the manufacturers. It examines the operationalization of CE through the analysis of one very specific transformation of an initially linear produced interior part to a circular one at a German premium automotive OEM. The key learnings derived from the case study were compared with recent literature on CE implementation strategies in manufacturing industries to prove them as best practices. Based on these, it is advised for organizations to first implement sustainable organizational values and a CE vision to create awareness and incentives for the transformation towards CE throughout all corporate departments. Another important learning is that circular product design, predisposing most of the product's future environmental impacts, serves as a crucial enabler for operationalizing a CE and increasing the number of circular parts on a vehicle.

In summary, the four perspectives show that established German premium automotive OEMs need to adapt in different ways to defend their position as innovation leaders in the industry. Various forces are putting pressure on them to rethink their competitive advantages, whether by analyzing and adapting to the needs of tomorrow's customers or by opening up to the outside world and entering into partnerships to satisfy shareholders and the market. From an internal perspective, incumbent OEMs need to pull key organizational levers to meet the challenge of innovation and stay ahead of the changing times. To be able to implement the required sustainability-oriented approaches such as CE, the OEM must adapt in the core and establish the corresponding values and visions as well as fundamental processes.

13. Overall limitations and future outlook

Admittedly, there are some limitations to this study. One limitation is the focus on German premium OEMs within the automotive industry. A global view of the topic that incorporates manufacturers from other countries of origin would go beyond the scope of this work. Hence, it would be a promising start for future research to look at other nations' automotive OEMs to prove the validity of this study’s findings. It would also be a promising contribution to analyze what kind of opportunities and challenges those manufacturers face while adapting to meet innovation requirements. Furthermore, this work project is limited to four different perspectives on the way an established car manufacturer must adapt to foster innovation to defend its leadership position. Future work projects should also provide analysis on a larger and broader set of perspectives, for example by including the challenge of innovating the entire value chain as an automotive OEM or by diving deeper into the role of an orchestrator and building a business ecosystem. Lastly, further research could integrate the review of the CASE technologies that are currently disrupting the automotive industry.

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Appendix

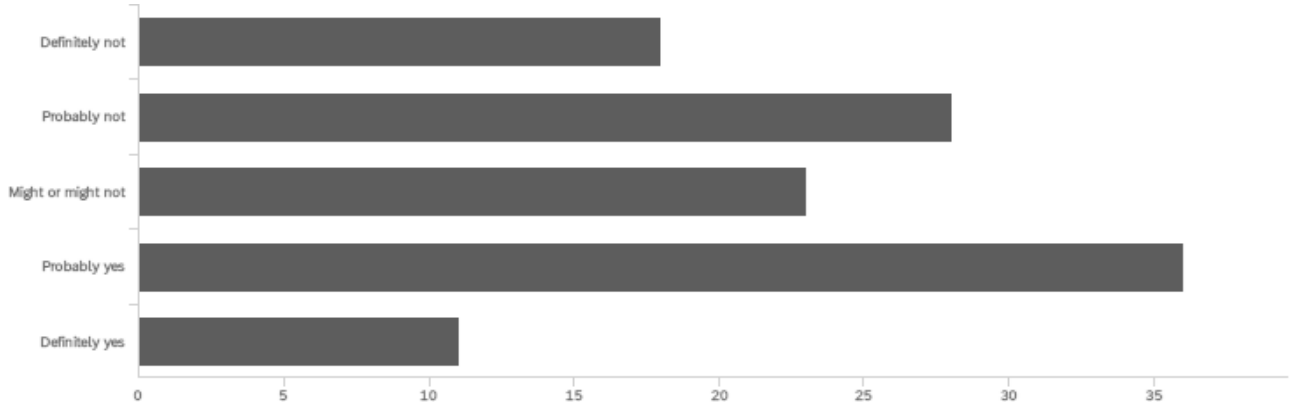
Appendix 2: ***Survey***

2.1 "If your household bought a brand-new car, how much do you like the overall experience after the purchase? (Rank each category from 1 to 5, being 5 the highest satisfaction)"

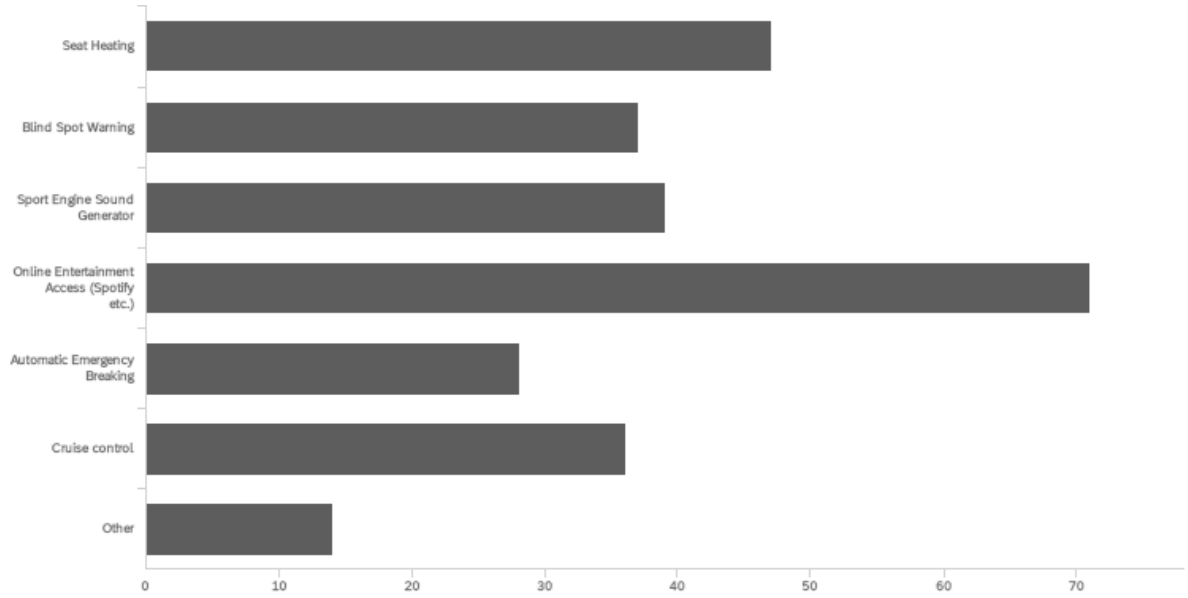
	Minimum	Maximum	Mean	Std Deviation	Variance	Count
Customer support	2	5	3.81	0.83	0.69	81
Subscription models	1	5	3.28	0.97	0.94	57
Brand mechanical support	2	5	3.85	0.83	0.69	79
Quality of materials	2	5	4.24	0.76	0.58	85

2.2 "A German premium car manufacturer has recently introduced flexible subscription options."

2.2.1 "You can temporarily unlock specific features for a monthly fee like seat heating, driving assistance, etc. Would you consider subscribing to such a feature in the future?"



2.2.2 "Which services should be available for booking in the subscription model? Please select all that apply."



Services	%	Count
Seat Heating	17.28%	47
Blind Spot Warning	13.60%	37
Sport Engine Sound Generator	14.34%	39
Online Entertainment Access (Spotify etc.)	26.10%	71
Automatic Emergency Breaking	10.29%	28
Cruise control	13.24%	36
Other	5.15%	14
Total	100.00%	272

2.2.3 "Willingness to pay for a certain feature How much are you willing to pay for seat heating as a service in a subscription model? (euro/month)"

	Average
€/month	21

2.2.4 "How much are you willing to pay for Driving Assistant/ Cruise Control as a service in a subscription model? (euro/month)"

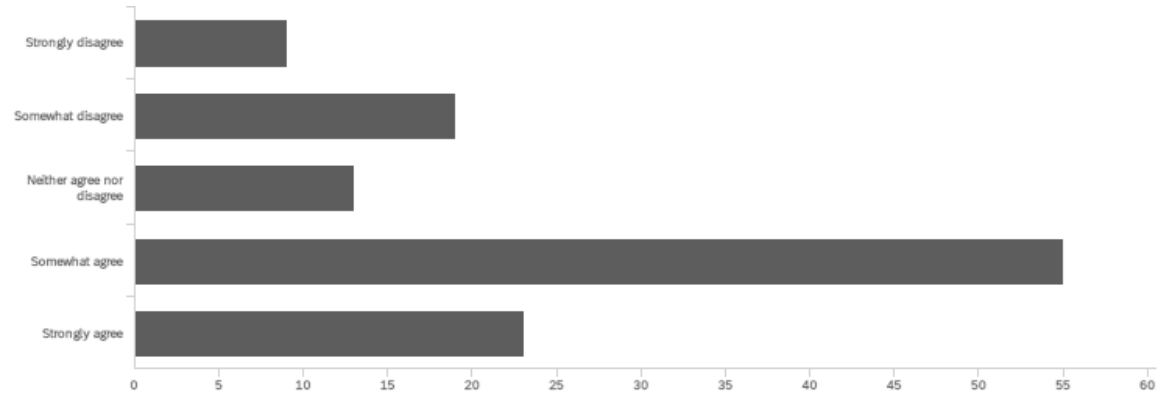
	Average
€/month	31

2.2.5 "How much are you willing to pay for Automatic Emergency Breaking as a service in a subscription model? (euro/month)"

	Average
€/month	33

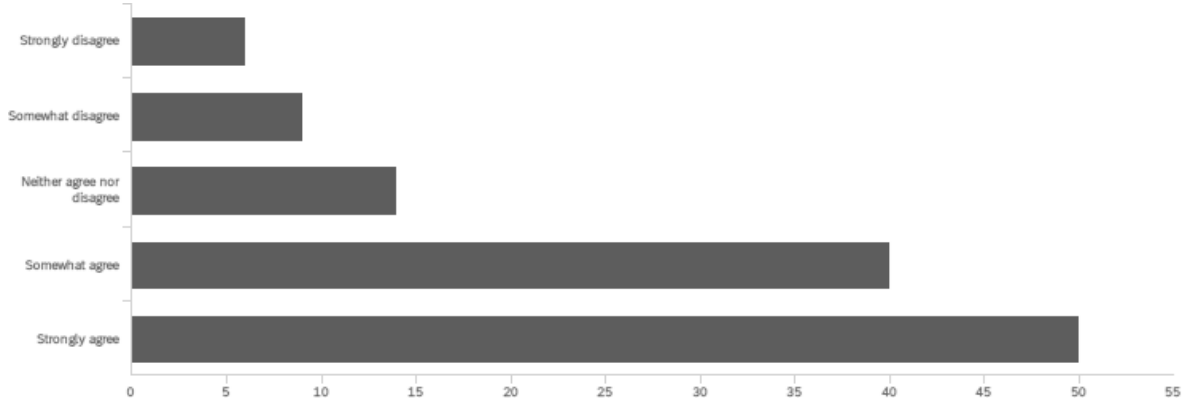
2.3 "In the following, you will see 3 different statements concerning car manufacturers' usage of your data for different purposes. Please indicate to what degree you confirm from strongly disagree to strongly agree."

2.3.1 "I tolerate that car brands capture and analyze all kinds of data (including my personal data) to use for future technology improvements"



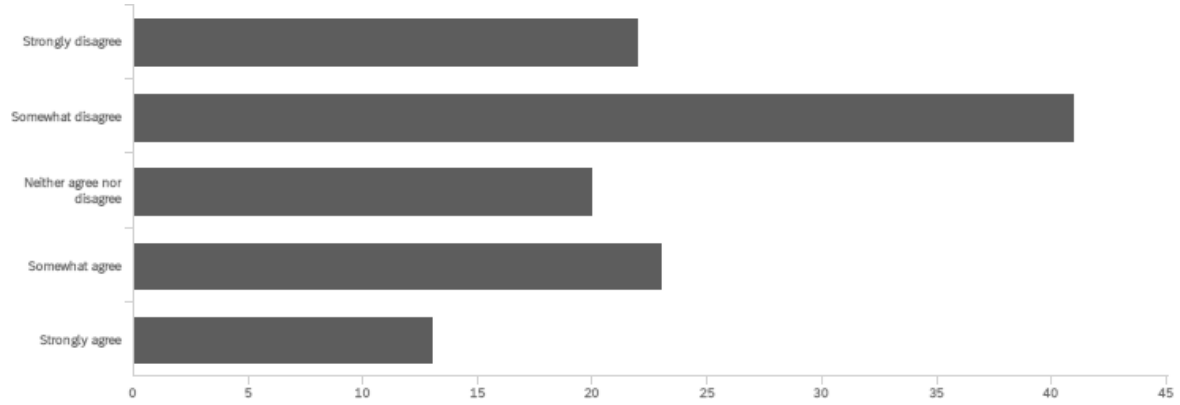
	Minimum	Maximum	Mean	Std Deviation	Variance	Count
General	1	5	3.52	1.2	1.43	122

2.3.2 "I tolerate that car brands capture and analyze all kinds of data (including my personal data) to use for future safety improvements"

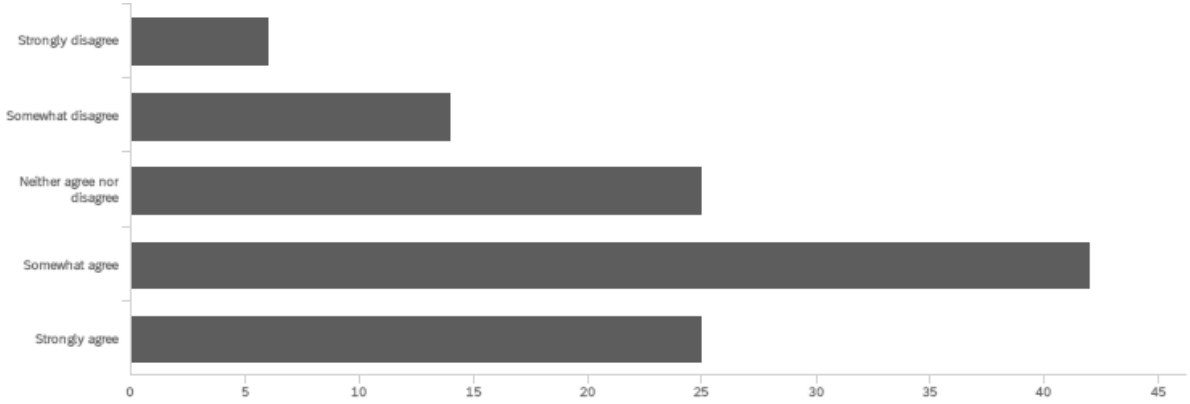


	Minimum	Maximum	Mean	Std Deviation	Variance	Count
General	1	5	4	1.14	1.29	119

2.3.3 "I tolerate that car brands capture and analyze all kinds of data (including my personal data) to use for future customized marketing"

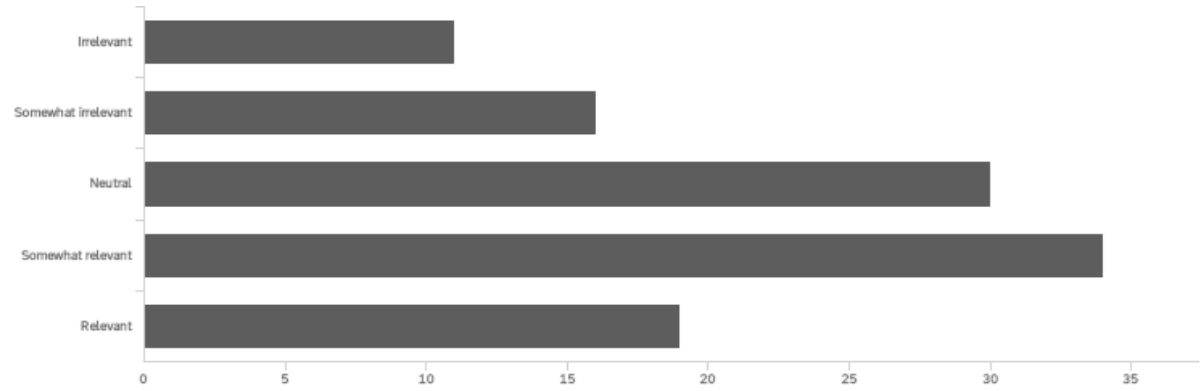


2.4 "I prefer a car that offers more third-party services versus a car that focuses on brand-owned features (e.g. Google Maps vs. navigation system of car brand)."



	Minimum	Maximum	Mean	Std Deviation	Variance	Count
General	1	5	3.59	1.12	1.26	112

2.5 "If you would buy a brand new car, would Circularity be a relevant purchase differentiator?"



	Minimum	Maximum	Mean	Std Deviation	Variance	Count
General	1	5	3.31	1.2	1.45	110

2.6 What do you as a potential future car buyer value most when choosing a car? Please rank the following accordingly.

	Minimum	Maximum	Mean	Std Deviation	Variance	Count
Sustainable friendly brand	1	7	4.54	1.86	3.46	102
Brand image/reputation	1	7	4.4	1.88	3.53	102
Low prices	1	7	4.77	1.8	3.23	102
High quality vehicles	1	7	2.5	1.67	2.78	102
Technology innovation	1	7	3.65	1.64	2.68	102
Customer support after sales	2	7	5.51	1.49	2.21	102
Safety	1	7	2.63	1.58	2.51	102

	1	2	3	4	5	6	7
Sustainable friendly brand	8	11	10	16	22	16	19
Brand image/reputation	6	14	15	18	18	9	22
Low prices	6	8	12	13	23	18	22
High quality vehicles	43	17	14	13	7	7	1
Technology innovation	10	18	24	16	17	14	3
Customer support after sales	0	4	9	16	8	32	33
Safety	29	30	18	10	7	6	2