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**Field lab – Automotive innovation**

# Innovation at established automotive manufacturers through organizational separation with the example of a wholly owned subsidiary

**JANA KATHARINA GEISELMANN**

Work project carried out under the supervision of:

**João Nuno Lopes de Castro**

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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. The individual section looks at organizational innovation from the inside. By reviewing a practical case, it elaborates on how OEMs can make use of separate units' contributions to corporate innovation. 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

| | |
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| ADS | Automated driving system |
| AI | Adjacent innovation |
| API | Application programming interface |
| BEV | Battery electric vehicle |
| CASE | Connected, autonomous, shared, electric |
| CI | Core innovation |
| $CO_2$ | Carbon dioxide |
| DDT | Dynamic driving task |
| EUR | Euro |
| EV | Electric vehicle |
| FCEV | Fuel cell electric vehicle |
| GHG | Greenhouse gases |
| GPS | Global positioning system |
| ICE | Internal combustion engine |
| M&A | Merger & acquisition |
| ODD | Operational design domain |
| OEM | Original equipment manufacturer |
| PEST | Political, economic, socio-Cultural, technological |
| PHEV | Plug-in hybrid vehicle |
| TI | Transformational innovation |
| VUCA | Volatility, uncertainty, complexity, ambiguity |

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# 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 costcutting 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).

[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 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 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)

# 9. The market's reaction on (alternative) M&A announcements in the automotive industry – An event study approach (Daniel Herrmann, 48705)

# 10. Innovation at established automotive manufacturers through organizational separation with the example of a wholly owned subsidiary (Jana Geiselmann, 48209)

## 10.1 Introduction

The fundamental challenge for any company is to ensure profitability by exploiting its existing business while also devoting energy to exploring innovations to continue to be successful in the future (March 1991). To achieve this ambidexterity, this study presents the benefits of corporate venturing for an automotive incumbent. Through organizational separation, the advantages of an established organization can be combined with the agile processes of smaller companies. As a practical example for a separate entity, the contribution of a technical subsidiary to innovation within the entire organization is examined through a case study. It is shown that this contribution depends on the assigned role definition of the subsidiary and its innovative strength. Concrete opportunities and obstacles are identified and recommendations for action are derived.

## 10.2 Methodology

Accordingly, the theoretical research on corporate innovation through organizational separation is complemented by a case study of an example company. The latter is a useful method to refine the existing theory (Yin 2009). In this way, the author of this study aims to shed more light on the topic and create a deeper understanding of the challenges associated with the innovation capability of companies. Further empirical evidence is gained from primary data collected through semi-structured interviews with external and internal experts from the example company. The semi-structured interview method gives the interviewees the freedom to dive deeper into the topic. To assess the results of the interviews and to help further analyze the findings, qualitative content analysis is chosen as a method.

## 10.3 Need and challenge for well-established organizations to innovate

### *10.3.1 Conditions of intensified competition and accelerated pace of change*

The challenge of responding to conditions of volatility, uncertainty, complexity, and ambiguity (VUCA) was first described as early as 1985 (Bennis and Nanus 1985). Volatility hereby refers to frequent change, uncertainty to unpredictable outcomes, complexity to the interconnectedness of factors, and ambiguity to the difficulty of fully understanding the situation (Wright and Wigmore 2022). This idea can also be applied to today's world, as companies need to be prepared for a variety of challenges. Globalization creates hyper-competition that forces companies to constantly improve and innovate. The competitive structure with a focus on the German automotive market is previously presented within the Porter’s Five Forces framework. Accordingly, information and communication technology and digitalization offer consumers more options when it comes to choosing the products they prefer. Also, changing consumer demands are characterized by great diversity and individualization, leading to shorter product life cycles and forcing a company to innovate and develop products that meet customer needs. In a very dynamic business environment, where unexpected changes often occur, a company must hence react quickly and must adapt and recognize the signs of the times to stay ahead of change (Troise et al. 2022).

### *10.3.2 Why well-established companies struggle with innovation*

When a company is founded, it's all about innovation. That changes once a start-up has achieved its first commercial success, and the new challenge is to make the business as profitable as possible. As the business matures and grows, the requirements for profitability become more stringent (Govindarajan and Trimble 2010). Established businesses have more to lose and are often reluctant to risk damaging the brand they have built by integrating new products into their product portfolio. Their existing business may be successful in the present, which makes it difficult to convey the urgency of the new (Weiss and Kanbach 2021).

However, the period in which a company can maintain its market leadership with some reliability to leverage its past innovations is getting shorter and shorter, putting pressure on even the most established companies to invest in new innovations (Ries 2011). To pursue innovation, a company should nevertheless be able to develop a long-term perspective to anticipate and monitor new technologies and market developments. Yet, especially for publicly traded companies, short-term requirements such as healthy earnings reports and dividend payments often lead to a safety-oriented mindset. An influential theory in the management literature refers to a so-called "innovator's dilemma" which implies that incumbent companies have difficulties managing innovations that are not initially beneficial to their existing customers (Christensen 1997).[5]

## 10.4 Innovation in a corporation

### *10.4.1 Innovation as a strategic goal*

Innovation is often understood simply as the creation of something new. However, for an innovation to be successful, two more requirements must be fulfilled. Innovation is not just

[5] See Appendix 2 *Example of an innovator's dilemma – Tesla*

about developing new products and services; it also needs a viable business model. The latter is successful if it creates added value for the customer and the added value is profitable for the company. Without these two additional components, it is merely a new product, but not an innovation (Viki, Toma and Gons 2017).

To include innovation projects in the core product portfolio at a later stage, innovation must be part of the company's strategic goals. A strategic approach to innovation provides guidance on which innovation projects the company should and should not consider. An innovation strategy guides decisions about how to deploy resources to achieve a company's innovation goals. It identifies technologies and markets a company should develop and exploit to create value within the limits of available resources (Dodgson, Gann and Salter 2008).

### *10.4.2 A balanced innovation portfolio*

For a company to realize its strategic innovation goals, it must strive for a balanced innovation portfolio in which different degrees of innovation are covered. Companies are encouraged to pursue different types of innovations in terms of their radicality (O'Reilly III and Tushman 2004). The recognized consultants Nagji and Tuff (2012) have coined a framework called the Innovation Ambition Matrix, which focuses on the relationship between markets and product portfolio innovation. It is used to determine a company's innovation ambitions and helps define its innovation strategy. The framework distinguishes between core innovation (CI), adjacent innovation (AI), and transformational innovation (TI). Core innovation activities include e.g., expanding the product range and improving the performance of existing products. They are quite safe bets. By incrementally adding new products and assets innovations, adjacent innovations take the company into new business areas without venturing too far from the core business. Transformational innovations are often referred to as breakthrough innovations. They are not directly related to existing markets or technologies but represent completely new products or services that are not extensions of existing products.

The consultants advise organizations to manage initiatives in all three categories (Nagji and Tuff 2012). Yet, innovations account for 85-90% of a company's portfolio on average. The reluctance to embrace more transformational innovations stems from the belief that they are too risky and that their benefits (if any) lie too far in the future. It is true that the risk of failure increases when venturing beyond incremental initiatives within familiar markets. Nevertheless, riskier TI should not be avoided, as they are essential to the health of a business.

The consultants found that companies that outperform their competitors allocate their innovation investments in a certain ratio: 70% for safe investments in optimizing existing products for existing customers (CI), 20% for less safe expansion of existing businesses into adjacent areas by putting existing capabilities to new uses (AI), and 10% for high-risk transformational initiatives (TI) (Nagji and Tuff 2012).

This average allocation based on a cross-industry and cross-geography analysis is said to be a good starting point for discussion, yet it is advised to consider that the perfect ratio varies from company to company based on the industry, the competitive position within an industry and the stage of development of a company[6] (Day 2007).

[6] See Appendix 3 *Different optimal innovation ratios for different firms*

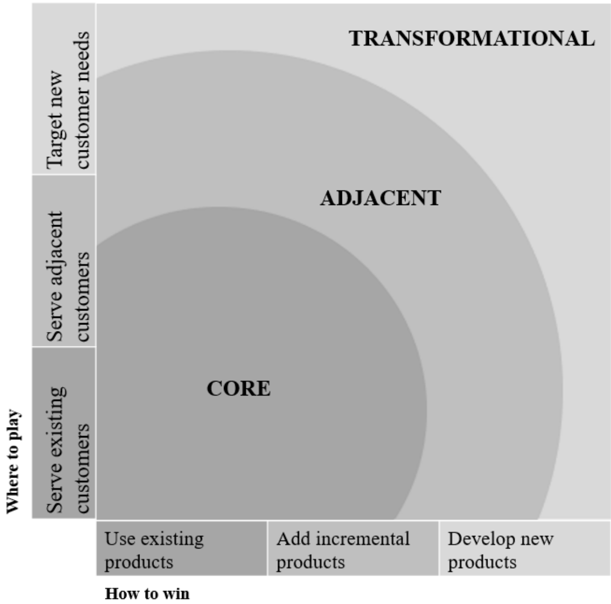


*Figure 1: Innovation Ambition Matrix (by the author, based on Nagji & Tuff 2012)*

### *10.4.3 Organizational ambidexterity*

Besides innovation capability needed to respond to changing market conditions. Yet, efficiency, standardization, and scale must continue to prevail in businesses to meet margin and profit expectations. Executives, therefore, face the challenge of maintaining consistency and fostering continuous improvement of the current offering while allowing the flexibility and experimentation which enables the business to create or respond to radical changes in the environment (Tushman and O'Reilly 1997).

The concept of ambidextrous organizations is assumed to help unite the two types of capabilities. When a company successfully employs organizational ambidexterity, it strikes a balance by exploiting established capabilities and exploring new opportunities. Exploitation hereby refers to the refinement and extension of existing competencies and technologies to address in particular the needs of today’s customers. Exploration, on the other hand, is practiced anticipating the expectations of tomorrow’s customers that demand new products with different attribute sets from the existing products (March 1991).

### 10.5 Corporate venturing for innovation

Achieving organizational ambidexterity requires combining the strategic competitive advantages that most established companies have developed with the lean approach and agile processes that many startups or smaller ventures follow (Forth and Gross-Selbeck 2022).

Corporate venturing can facilitate access to growth through innovation by addressing innovation needs in a variety of ways, from collaborating with startups or other partners to mimicking a startup's structures internally.

The concept of external corporate venturing is analyzed in the collaborative part of this work project in the context of corporate networks and open innovation. Internal corporate venturing, on the other hand, is concerned with how a company promotes and manages innovative, entrepreneurial activities internally. These are often tackled by an intrapreneur or a venture team (Burns 2020). Tushman and O'Reilly III (2004) argue that organizational ambidexterity can be achieved through an organizational separation with multiple, contradictory structures and cultures reconciled by a single vision and a tightly integrated leadership team. This is in line with Christensen (1997) who argues that innovations are best developed at separate sites with great autonomy, free from the bureaucracy of the main organization and led by a high-level manager. Many incumbents, therefore, establish a separate, resourced business unit to foster innovation within the organization.

A subsidiary is a possible form of a business unit and can provide significant value to the parent company. This includes the creation of initiatives through problem-solving, active participation, and linking improvement activities to strategic goals. The associated creation of coalescing knowledge as a relevant intangible asset between the parent company and its subsidiary contributes to the innovation of both the subsidiary and the company (Bessant, Caffyn and

Gallagher 2001). When subsidiaries, however, adopt more narrowly defined, specialized implementer roles, the opportunity to augment knowledge and contribute collectively to corporate innovation will likely deteriorate. It is therefore recommended that the subsidiary neither becomes a detached satellite nor an extended workbench of the parent company (Leubner et al. 2020).

## 10.6 Case study innovation contribution from a tech subsidiary of a German premium automotive OEM

The following study examines the specific case of a wholly owned tech subsidiary of a German automotive premium OEM. The subsidiary faces the previously described challenge of contributing to innovation within the parent organization. It therefore pursues the goal of being perceived as an innovation driver within the whole organization and seeks to avoid taking on the narrower defined role of a pure implementer instead.

The data on this case is derived from the internal discussions and interviews conducted by the author.[7]

### *10.6.1 Introducing the subsidiary as an intra-group partner*

The automotive OEM is one of the most successful, established automotive companies in the world and one of the largest suppliers of premium passenger cars. The subsidiary as an intra-group tech partner is the group's biggest wholly owned software development subsidiary that almost exclusively serves customers within the organization. The subsidiary was founded as a project spin-off. What began with seven employees has developed into a company that today employs more than 1,000 people. Naturally, work tasks become more and more specialized with a growing number of resources. In addition, the company organizes itself around its

[7] See chapter *Analysis of the primary data*

products, and processes are needed to capture existing practices and to run efficiently.

### *10.6.2 Vision and innovation strategy*

The subsidiary sees its opportunity for proactive strategic positioning based on the progressive transformation of the parent company to a software-driven company and the role of tech in the brand promise and positioning. As part of its strategy, it formulates the goal of being perceived as an innovation driver within the parent organization by embedding innovation and technology more firmly in their daily work.

### *10.6.3 Status quo corporate innovation*

As a basis for its strategy and to assess the status quo of its business, the company has set up an internal business health check using a traffic light system.[8] In this way, the subsidiary determined that its innovation criterion, an innovative product portfolio, is not met. To understand this classification, the innovation activities are classified by the author with the help of the *Innovation Ambition framework* presented in paragraph 10.4.2.[9] The application of the framework reveals that some activities can be assigned to the fields of adjacent and also transformational clusters. However, it also demonstrates that the current innovation portfolio is dominated by activities assigned to making incremental changes to existing products.

### *10.6.4 Target innovation ratio according to literature*

As suggested by the literature, the *Innovation Ratio* model presented in paragraph 10.4.2 is applied to this case to find an optimal ratio for the innovation portfolio. Therefore, the industry the company operates in, its competitive positioning, and its stage of development are in the following analyzed. The subsidiary develops products for the automotive industry, an industry

[8] Red: criteria not met; yellow: criteria partially met; green: criteria fully met
[9] See Appendix 4 *Status quo innovation ambition*

that is experiencing an unprecedented level of transformation (Capgemini Automotive Technovision Team 2022). The company itself operates in the technology industry which is predestined to focus not on improving core products but on more transformational releases (Nagji and Tuff 2012). As already mentioned, the parent company one of the world's leading car manufacturers. It is typical for a company that wants to maintain its leading position in the market to focus on the core initiatives and remove the risk that comes with transformational activities (Nagji and Tuff 2012). The company of this case however is a tech subsidiary of the OEM and competes with other internal partners for its innovative and technological reputation. Lastly, when taking the company's intermediate stage of development into account, the subsidiary may shift its emphasis toward protecting and growing its core. However, this approach is only a short-term solution reflecting only the current innovation stage of the company. All in all, according to the framework, the subsidiary should aim for a ratio for its innovation portfolio that lies between that of the parent organization as a mature and market-leading OEM in the automotive industry and that of itself operating in the technology sector.[10] Hence it is advised to shift its focus to more adjacent and transformational products within its innovation portfolio.

#### *10.6.5 Analysis of the primary data*

To evaluate the secondary data and provide empirical evidence, primary data were collected through interviews and conversations with experts inside and outside the subsidiary.[11] For the evaluation of the expert interviews, these were transcribed to be able to record what was said in written form and supplemented by notes from conversations with other experts. The resulting documentation was used for qualitative content analysis (Mayring 2022). A structuring content

[10] See Appendix 3 *Different optimal innovation ratios for different firms*
[11] See Appendix 5 *Overview interviewees*

analysis and a deductive category application were performed in which the deductive main categories were extended by inductive subcategories as further subdivision aspects emerged.[12] The following main categories were developed. C1: Imperative for innovation, C2: Competitiveness, C3: Innovation prerequisites, C4: Business model impact. The results are described in detail in Appendix 6.

### *10.6.6 Discussion*

In this part of the study, the empirical results are consolidated and related in the form of a SWOT analysis[13], which presents the wholly owned subsidiary's strengths, weaknesses, opportunities and threats concerning the goal of being perceived as an innovation driver. A balanced innovation portfolio being the prerequisite, the ratio derived from the framework is challenged based on the input from the internal and external experts.

*Weaknesses*

The fact that it is not currently perceived as an innovation driver and the lack of a focused innovation portfolio can be characterized as disadvantages for the subsidiary. The limited liquidity due to the profit transfer agreement also pose a challenge with regard to innovation investments. Due to the margin constraints imposed by this structure, only a limited return is achieved, resulting in increased risk for TI investments. The transformative product *"smarT"*[14] required commitment and seed capital from the parent company and is not yet profitable, hence must be financed from the current business. This makes it difficult to tackle major innovations to increase the TI share within the innovation ratio. In addition, the parent company is the (almost) sole customer of the subsidiary. Representing consumer demand, it significantly influences portfolio decisions. What is more, not fully integrating the subsidiary into the

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[12] See Appendix 6 *Qualitative content analysis of qualitative interviews*
[13] See Appendix 7 *SWOT Analysis: Innovation contribution of the subsidiary*
[14] Name changed for anonymizing reasons; see Appendix 4 *Status quo innovation ambition*

solution definition processes weakens the latter in terms of solution design. Finally, not being the first port of call for innovation and technology makes it difficult for the subsidiary to drive innovation within the parent organization.

*Threats*

These weaknesses lead to potential threats to the subsidiary's ability to innovate. This in turn poses the risk of adapting more a narrowly defined implementer role. The latter can lead to strong competition from other software-developing companies; especially offshore software-developing companies as they are typically more cost-effective for the parent company than the German subsidiary from this case.

*Strengths*

On the other hand, the subsidiary as a separate unit has relevant methodological strengths in the form of agile organizational structures that present a basis for successful innovation processes. Another strength is the expert knowledge and deep insight into the products, processes, and requirements of the parent organization as well as the holistic and context-related view of the IT systems. Economic dependence, which was previously classified as a weakness, also implies financial security from the parent company compared to companies operating on the free market.

*Opportunities*

To prevent the risk of adapting the role of a pure implementer, the subsidiary should leverage its strengths towards contributing to corporate innovation of the parent organization. Some internal initiatives are representing the awareness that is already existing within the subsidiary. One initiative intends to counteract the tendency for the subsidiary to be tasked only with casting the final product solution in software, and thus to be involved only in the final steps of the process. The initiative's current approaches are a cultural mindset shift toward a more product-oriented way of thinking and empowering employees by providing them with an appropriate methodology. The popular Scaled Agile Framework (SAFe®) approach applied within the subsidiary is an enabler to apply Lean-Agile and Scrum practices. In this context, it provides a framework for collaborative working between the parent organization and subsidiary and focuses on cross-functional teams that are needed to explore customer needs and problems and then build and deliver solutions to customers. As part of this initiative, the subsidiary is seeking earlier entry into the solution development process and aims to achieve greater sovereignty over the implementation steps of the process. A central innovation management initiative intends fostering more transformative idea generation. The initiative is currently working on the conception of a framework to especially promote this dimension of innovation.

The key takeaways of this case study relate to the application of the theoretical frameworks to the case of a separate entity. First, it is indeed helpful to apply the *Innovation Ambition Framework* to the real-world case to determine the status quo of innovation. Second, however, it is important to see the ratio derived from the *Innovation Ratio Framework* only as a basis for discussion. Third, a realistic target ratio should be derived based on the entity’s purpose and business model as a further dimension. Fourth, appropriate actions should be derived for each type of innovation to achieve a realistic target ratio in an evolutionary process.

## 10.7 Conclusion and Recommendations

In this section, the results of this work are used as the basis for the final recommendations for action. Corporate innovation through a balanced innovation portfolio of core, adjacent and transformational innovation activities as well as organizational ambidexterity with regard to the balancing act between exploitation and exploration are crucial for the competitiveness of companies under today's VUCA conditions. This is especially true for established OEMs in the automotive industry as the latter undergoes an unprecedented transformation. They can meet these challenges through corporate venturing and organizational separation, for example, by leveraging valuable contributions to innovation through a subsidiary. This in turn can only be achieved if the subsidiary is neither a detached satellite nor an extended workbench.

The case study shows the challenge for a subsidiary not to take on the characteristics of a mere implementer, but to be perceived as an innovation driver and thus contribute to innovation within the parent organization. It therefore wants to establish an innovative product portfolio as part of its innovation strategy. The author uses two theoretical frameworks to assess the status quo of innovation within the subsidiary and to derive an optimal ratio of core, adjacent and transformational types of innovation accordingly. The resulting ratio suggests a significant increase in the transformational nature of innovation compared to the status quo and advises continued focus on core and adjacent innovations.

The collection of empirical evidence reveals that to find a realistic target ratio for a subsidiary, the implications of its business model need to be considered. On the one hand, the constellation as a subsidiary of an established company offers financial security, but on the other hand, the profit transfer agreement also implies limited availability of financial resources for investments as well as margin restrictions. The optimal ratio is therefore influenced by the economic dependence on its parent organization, especially with regard to heavier innovation investments needed for TI.

For a subsidiary to nevertheless be able to develop all three kinds of innovation activities, it is advised to take on certain actions. Based on its financial limitations, it is generally recommended to manage the available resources efficiently and deploy them in a targeted manner. It is, therefore, to consider the success factors of an innovation including validating its benefits for the customer and its profitability for the company. Only if the innovation has potential in terms of a successful business case that brings benefits to the customer and the company, the project should be further pursued. Otherwise, the resources should be made available for other innovation projects.

CI and AI are rather close to the core business, hence problems should be identified and understood by problem solvers at the root before they are solved. In other words, to enable targeted core and adjacent innovation capabilities, it is necessary to achieve an early integration of the subsidiary's product teams into solution definition processes that currently largely take place at the parent company. With the corresponding goal of promoting embedding in the parent company's processes, the subsidiary can leverage its expertise and make a valuable contribution to the entire company through knowledge transfer, the creation of coalescing knowledge, and relevant CI and AI. The internal initiatives intending to create awareness starting to play their art in achieving this present an opportunity for this subsidiary. It should strengthen these initiatives to continue working on an enablement of CI and AI by seeking a bottom-up integration of subsidiary's product teams into the whole solution definition process.

To contribute more transformative innovation, it is equally important for the subsidiary to work against the role of implementer and for its role as an innovation driver. Only when the subsidiary is perceived as the first point of contact for innovation and technology will it face requests from the parent organization for more transformative innovation - either to generate ideas or to collaborate as an internal challenger with the parent company or an external disruptor on implementing an idea. To realize this, the subsidiary needs to develop a valid approach to its innovation management that enables innovation activities beyond existing projects. It therefore needs to free up resources and allocate them to more centralized, temporary teams. These teams then pursue the goal of identifying and meeting the needs of tomorrow's customers through innovative technologies. For this, an appropriate framework that manages the process from the idea generation to the implementation is crucial and needs to be developed to gradually include more TI capabilities.

As an additional recommendation, the subsidiary should explore the potential for incorporating more customer insights competencies to enrich its innovation capabilities. This capability presents the foundation for identifying consumer needs and real problems for which solutions can then be developed within the subsidiary as an innovation and technology expert.

### 10.8 Limitations and Further Outlook

This study covers a specific part of the broad field of the organizational aspects of innovation. It focuses and is limited to what is relevant to the case of a subsidiary as a potential lever for innovation in established organizations and the opportunities and challenges associated with it. Thus, there is much more to explore when it comes to making the most of innovation opportunities, such as different corporate venturing levers and innovation challenges with an internal view on different types of organizations and industries. It is recommended that other internal aspects such as creating a culture of innovation and strong leadership characteristics needed for employees to develop an innovative mindset and take ownership to be further explored. In addition, this study focuses on the initial stages of business innovation such as developing an innovation strategy, defining an appropriate innovation portfolio, and designing different innovation approaches, but not on innovation management itself, including the methods and processes for realizing innovations.

## 11. Circular product transformation in the automotive industry – Case study of a German premium manufacturer (Lucas Benedikt Schäfer, 50685)

## 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.

## References


&Audi. 2019. *The Pulse of Autonomous Driving.* Survey Report , Ingolstadt: AUDI AG.

Abdelkader, Ghadeer, Khalid Elgazzar, and Alaa Khamis. 2021. “Connected Vehicles: Technology Review, State of the Art, Challenges and Opportunities.” *National Center for Biotechnology Information.*

ACEA. 2017. "ACEA." *ACEA.* July 01. Accessed December 08, 2022. https://www.acea.auto/files/ACEA_Pocket_Guide_2017-2018.pdf.

—. 2022. *ACEA.* April 04. Accessed December 14, 2022. https://www.acea.auto/figure/rd-investment-by-top-10-industrial-sectors-in-eu/.

Ahmed, Hafiz, Ying Huang, Pan Lu, and Raj Bridgelall. 2022. “Technology Developments and Impacts of Connected and Autonomous Vehicles: An Overview.” *Smart Cities.*

Allied Market Research. 2022. *Fleet Management Market Statistics 2022-2030.* Allied Market Research.

Andersen, Derek. 2022. *invoca.* 7 29. Accessed 11 17, 2022. https://www.invoca.com/blog/improve-customer-experience-automotive.

Arena, Fabrizio, Daniele Spera, and Fabio Laguardia. 2017. "Arthur D. Little." Accessed December 10, 2022. https://www.adlittle.com/sites/default/files/viewpoints/ADL_Future%20of%20Fuel%20cell%20vehicles.pdf.

Audi AG. 2022. "Audi AG." March 17. Accessed November 05, 2022. https://www.audi.com/content/dam/gbp2/en/company/investor-relations/reports-and-key-figures/annual-reports/audi-report-2021.pdf.

Automobile Woche. 2018. "Studie: Markentreue junger Autokäufer lässt nach."

Bell Rae, John. n.d. *Britannica.* Accessed 11 24, 2022.

https://www.britannica.com/technology/automotive-industry/The-modern-industry.

Bennis, Warren, and Burt Nanus. 1985. *Leaders : The Strategies For Taking Charge.* New York: Harper and Row.

Bessant, John, Sarah Caffyn, and Maeve Gallagher. 2001. "An evolutionary model of continuous improvement behavior." *Technovation* 67,77.

Beverly Hills Magazin. 2022. *The Psychology of luxury car buyers.* The Beverly Hills Magazin.

Birkinshaw, Julian. 2019. "Ecosystem Businesses Are Changing the Rules of Strategy." *Harvard Business Review* n.p.

BMW Group. 2022. "BMW Group." *BMW Group.* March 16. Accessed December 08, 2022. https://www.bmwgroup.com/en/report/2021/downloads/BMW-Group-Report-2021-en.pdf.

—. 2022. *BMW Group.* December 02. Accessed December 10, 2022. https://www.press.bmwgroup.com/global/article/detail/T0406122EN/bmw-group-commences-production-of-small-series-hydrogen-powered-model?language=en.

Bowman, Karen, and Herald Proff. 2022. *Deloitte.* Accessed 12 12, 2022. https://www2.deloitte.com/us/en/pages/consumer-business/articles/global-automotive-consumer-study.html.

Bratzel, Prof. Dr. Stefan. 2021. *Center of Automotive Management.* 08 22. Accessed 12 08, 2022. https://auto-institut.de/en/automotiveinnovations/automotiveinnovations-ranking-of-the-most-innovative-automotive-oems-and-premium-brands-2021/.

Burns , Paul. 2020. *Corporate Entrepreneurship and Innovation, 4th Edition.* London: Red Globe Press.

Capgemini Automotive Technovision Team. 2022. *TechnoVision 2022: Being like water.* Trend Report, n.p.: Capgemini.

CARIAD. 2022. *Volkswagen AG.* August 02. Accessed December 10, 2022.

https://www.volkswagenag.com/de/group/brands-and-models/cariad.html.

Chesbrough, Henry W. 2003. *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston: Harvard Business School Press.

China Society of Automotive Engineers. 2020. *China SAE.* October 27. Accessed December 10, 2022. http://en.sae-china.org/a3967.html.

Christensen, Clayton M. 1997. *The Innovator's Dilemma.* Boston: Harvard Business School Publishing.

Chui, Janis. 2022. *Compass IOT.* https://www.compassiot.com.au/media/everything-you-need-to-know-about-connected-vehicles.

Cole, Michael. 2021. *BBC.* July 30. Accessed December 14, 2022. https://www.bbc.com/storyworks/ceoedit/michael-cole.

Council of the European Union. 2022. "Council of the European Union." November 16. Accessed December 09, 2022. https://data.consilium.europa.eu/doc/document/ST-14869-2022-INIT/en/pdf.

Day, George S. 2007. "Is It Real? Can We Win? Is It Worth Doing? - Managing Risk and Reward in an Innovation Portfolio." *Harvard Business Review* 110-120.

Destatis. 2022. *Statistisches Bundesamt.* February 24. Accessed December 08, 2022. https://www.destatis.de/EN/Press/2022/02/PE22_N009_51.html.

Diess, Herbert. 2021. "Volkswagen AG." July 13. Accessed December 10, 2022. https://www.volkswagenag.com/presence/konzern/strategie/2021/EN_Herbert-Diess_Speech-NEW-AUTO-Strategy-Presentation.pdf.

Dobrindt, Alexander. 2016. "BearingPoint." Accessed December 14, 2022. https://www.bearingpoint.com/files/germany-a-leading-supplier-for-connected-driving.pdf?download=0&itemId=366611.

Dodgson, Mark, David Gann, and Ammon Salter. 2008. *The Management of Technological*

*Innovation.* New York: Oxford University Press.

European Commission. 2020. "EUR-Lex." December 09. Accessed December 09, 2022. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0789.

European Environment Agency. 2022. *European Environment Agency.* October 26. Accessed December 09, 2022. https://www.eea.europa.eu/ims/new-registrations-of-electric-vehicles.

European Union. 2019. *Hydrogen roadmap Europe : a sustainable pathway for the European energy transition.* Roadmap, Luxembourg: Publications Office of the European Union.

Federal Ministry for Digital and Transport . 2021. "Germany will be the world leader in autonomous driving." *bmdv.bund.de* . July 27. Accessed December 09, 2022. https://bmdv.bund.de/SharedDocs/EN/Articles/DG/act-on-autonomous-driving.html.

Forth, Patrick, and Stefan Gross-Selbeck. 2022. "A Proven Model for Corporate Venturing." *BCG.com/publications.* June 15. Accessed December 02, 2022. https://www.bcg.com/publications/2022/corporate-venturing-models.

Fuel Cell & Hydrogen Energy Association. 2020. "Road Map to a US Hydrogen Economy." Report, Washington DC.

Gassmann, Oliver. 2006. "Opening up the innovation process: towards an agenda." *R&D Management, vol. 36, no. 3* 223-228.

Germany Trade & Invest . 2022. *The Automotive Industry in Germany.* Germany Trade & Invest.

Govindarajan, Vijay, and Chris Trimble. 2010. *The Other Side of Innovation: Solving the Execution Challenge.* Boston: Harvard Business Review Press.

Goyal, Anchit. 2021. "A Critical Analysis of Porter's 5 Forces Model of Competitive Advantage."

Greenberg, Andy. 2021. "Hackers Remotely Kill a Jeep on the Highway—With Me in It."

*wired.* July n.d. Accessed December 09, 2022. https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/.

Grimaldi, Rosa, and Alessandro Grandi. 2005. "Business Incubators and New Venture Creation: An Assessment of Incubating Models." *Technovation 25.2* 111-121.

GTAI. 2022. "GTAI." *GTAI.* June. Accessed December 08, 2022. https://www.gtai.de/resource/blob/64100/8fc3cff5774c2ec699172cd823a0ec0e/20220711_IO_Automotive_WEB.pdf.

Handelsblatt. 2022. *Konflikt zwischen Autobauern und Zulieferern eskaliert – jetzt will der mächtigste Verband schlichten.* Handelsblatt.com.

Harting, Andreas, and Dr. Harald Proff. n.d. "Ecosystems Automotive." *Deloitte.com* . Accessed December 09, 2022. https://www2.deloitte.com/de/de/pages/manufacturing/articles/eco-systems-automotive-deloitte-deutschland-manufacturing.html.

Heineke, Kersten, and Ruth Heuss. 2021. *What's next for autonomous vehicles?* Survey report , n.p.: McKinsey & Company.

ibisworld. 2022. *ibisworld.* 10 31. Accessed 11 24, 2022. https://www.ibisworld.com/global/market-size/global-car-automobile-sales/.

International Energy Agency. 2022. *Global EV Outlook 2022: Securing supplies for an electric future.* Outlook, France: IEA Publications.

International Transport Forum. 2021. "ITF Transport Outlook 2021." Outlook.

Krishnakumar, Mukilan. 2022. "The 6 Autonomous Driving Levels Explained." *Weights & Biases* . November 08. Accessed December 09, 2022. https://wandb.ai/mukilan/autonomous-cars/reports/The-6-Autonomous-Driving-Levels-Explained--VmlldzoyNTcwOTQ1.

Lo, Sonia M., and Yu-Anne Shiah. 2016. "Associating the motivation with the practices of firms going green: the moderator role of environmental uncertainty." *Supply Chain Management*, 485-498.

March, James. 1991. "Exploration and Exploitation in Organizational Learning." *Organization Science* 71-87.

Mayring, Philipp. 2022. *Qualitative Content Analysis: A Step-By-Step Guide.* London: SAGE Publications Limited.

McKinsey. 2016. *Automotive revolution – perspective towards 2030.* McKinsey & Company.

McKinsey. 2022. *Five trends shaping tomorrow's luxury-car market.* McKinsey & Company.

—. 2022. *McKinsey & Company.* May 23. Accessed December 09, 2022. https://www.mckinsey.de/news/presse/2022-05-23-evi-2022.

McKinsey. 2022. *The future of automotive computing: Cloud and edge.* McKinsey & Company.

McKinsey. 2019. *The new realities of premium mobility.* McKinsey & Company.

Mercedes-Benz Group AG. 2022. "Approved for commercial use: Mercedes-Benz and Bosch driverless parking system." *group.mercedes-benz.com.* November 30. Accessed December 09, 2022. https://group.mercedes-benz.com/innovation/product-innovation/autonomous-driving/intelligent-park-pilot.html.

Mercedes-Benz. 2022. *Mercdes-Benz Group.* May 19. Accessed December 08, 2022. https://group.mercedes-benz.com/investors/events/2022-mercedes-benz-group-economics-of-desire.html.

Miller, Randall, Martin Cardell, and Gaurav Batra. 2022. *EY.* May 23. Accessed December 10, 2022. https://www.ey.com/en_gl/automotive-transportation/mobility-consumer-index-wave-3.

Nagji, Bansi, and Geoff Tuff. 2012. "Managing Your Innovation Portfolio." *Harvard Business Review* 66-74.

Nöhl, Markus. 2013. "Automobile Symbole im Umbruch. Automobilkritik und

Symbolproduktion am Ende des Booms 1965-1975." In *Automobilindustrie 1945–2000: Eine Schlüsselindustrie zwischen Boom und Krise*, by Stephanie Tilly and Florian Triebel, edited by Stephanie Tilly and Florian Triebel, 363-387. München: Oldenbourg Wissenschaftsverlag.

O'Reilly III, Charles A., and Michael L. Tushman. 2004. "The Ambidextrous Organization." *Harvard Business Review 82, no. 4* 74-81.

Porter, Michael. 1979. "How Competitive Forces Shape Strategy." *Havard Business Review.*

Precedence Research. n.d. *Precedence Research.* Accessed 11 24, 2022. https://www.precedenceresearch.com/automotive-oem-market.

Proff, Dr. Harald, Thomas Pottebaum, and Philipp Wolf. 2019. *Autonomous Driving: Moonshot Project with Quantum Leap from Hardware to Software & AI Focus.* Deloitte.

Ries, Eric. 2011. *The Lean Startup.* New York: Crown Publishing Group.

Roland Berger . 2022. *Automotive Trends.* Roland Berger GmbH.

Roland Berger. 2022. *Automotive Sector: Repositioning required for Germany's flagship industry players.* Roland Berger GmbH.

Roper, Stephen, Jun Du, and Jim Love. 2008. "Modelling the innovation value chain." *Research Policy, vol. 37* 961-977.

SAE International. 2021. *SAE J3016 Levels of Driving Automation* . n.p.: SAE International.

Sarafin, Greg. 2021. "Companies that utilize business ecosystems will be better positioned to drive innovation and capital efficiency to create customer value." *EY.* April 23. Accessed December 09, 2022. https://www.ey.com/en_gl/alliances/what-business-ecosystem-means-and-why-it-matters.

Shah, Jay. 2022. *Robosoft Technologies.* 01 04. Accessed 11 18, 2022. https://www.robosoftin.com/blog/customer-experience-trends-in-automotive-industry-digital-transformation.

Staples, Sarah. 2019. *BBC.* August 22. Accessed December 08, 2022. https://www.bbc.com/travel/article/20190821-how-germany-became-the-country-of-cars.

Strategy&. n.d. "Strategy&." Accessed December 09, 2022. https://www.strategyand.pwc.com/de/en/industries/automotive/digital-auto-report-2022/strategyand-digital-auto-report-2022.pdf.

Szász, Levente, Ottó Csíki, and Béla-Gergely Rácz. 2021. "Sustainability management in the global automotive industry: A theoretical model and survey study." *International Journal of Production Economics*, March 10.

Tagesschau. 2022. *Chinas Autobauer in den Startlöchern.* Tagesschau.de. https://www.tagesschau.de/wirtschaft/unternehmen/pariser-autosalon-china-elektroautos-premiummodelle-byd-nio-great-wall-autobauer-bmw-vw-mercedes-101.html.

Talay, M.B., R.J. Calantone, and C.M. Voorhees. 2014. "Coevolutionary Dynamics of Automotive Competition: Product Innovation, Change, and Marketplace Survival." *Journal of Product Innovation Management*, 61-78.

Thun, Jörn-Henrik, and Andrea Müller. 2010. "An empirical analysis of green supply chain management in the german automotive industry." *Business Strategy and the Environment*, February: 119-132.

Tushman, Michael A, and Charles A O'Reilly. 1997. *Winning Through Innovation: A Practical Guide to Leading Organizational Change and Renewal.* Boston: Harvard Business School Press.

Tyborski, Roman. 2022. *Handelsblatt.* June 07. Accessed December 10, 2022. https://www.handelsblatt.com/unternehmen/industrie/vw-software-tochter-cariad-mehr-chaos-als-koordiniertes-programmieren/28403258.html.

VDIK. 2022. *PKW-Markt.* Verband der Internationalen Kraftfahrzeughersteller e.V. (VDIK).

Viki, Tendayi, Dan Toma, and Esther Gons. 2017. *The Corporate Startup: How Established Companies Can Develop Successful Innovation Ecosystems.* Deventer: Vakmedianet Management B.V.

Weiss, Lysander, and Dominik K. Kanbach. 2021. "Toward an integrated framework of corporate venturing for organizational ambidexterity as a dynamic capability." *Management Review Quarterly.*

Wondershare EdrawMax. n.d. *Wondershare EdrawMax.* Accessed 11 24, 2022. https://www.edrawmax.com/article/automotive-industry-value-chain-analysis.html.

Wright , Gavin, and Ivy Wigmore. 2022. "VUCA (volatility, uncertainty, complexity and ambiguity)." *TechTarget.* May 31. Accessed December 11, 2022. https://www.techtarget.com/whatis/definition/VUCA-volatility-uncertainty-complexity-and-ambiguity.

Yin, Robert K. 2009. *Case study research: Design and methods. Vol. 5.* London: Sage Publications.

Zhou, Andy, Golden Liu, Tony Wang, Ricky Liu, Yi Zhou, and Wilson Liu. 2021. "Deloitte." February 25. Accessed December 10, 2022. https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/consumer-business/deloitte-cn-cb-software-defines-vehicles-en-210225.pdf.

# Appendix

*Appendix 1:* ***SAE Levels of Driving Automation***

| Level | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 |
|---|---|---|---|---|---|---|
| Auto-mation | No Driving Automation | Driver Assistance | Partial Driving Automation | Conditional Driving Automation | High Driving Automation | Full Driving Automation |
| Role of driver | In charge of the entire DDT | Performs parts of DDT not performed by ADS; is in monitoring mode at all times and intervenes as necessary | Performs parts of DDT not performed by ADS; is in monitoring mode at all times and intervenes as necessary | Becomes DDT fallback-ready user when ADS is engaged and is receptive to a request to intervene | Becomes a passenger when ADS is engaged, may perform the DDT after the ADS reaches its ODD limit | Becomes a passenger when ADS is engaged |
| Role of ADS | Does not perform any part of the DDT | Performs part of DDT by executing either longitudinal or lateral vehicle motion control task | Performs part of DDT by executing both longitudinal and lateral vehicle motion control task | Performs entire DDT within its ODD and determines whether ODD limits are about to be exceeded | Performs entire DDT but is geofenced to particular areas | Performs the entire DDT under all conditions and with no geofencing |

*Figure 2: SAE Levels of Driving Automation (by the author, based on SAE 2021)*

*Appendix 2:* ***Example of an innovator's dilemma - Tesla***

Christensen (1997) describes an example of the so-called innovator's dilemma in the automotive industry, where incumbents know about innovative technologies but do not engage with them because they focus on and invest in products and services that their most profitable customers want. It was previously assumed that no automotive company was threatened by electric cars, as the mainstream customers' demanded reliable gasoline engines. Electric engines were seen as a technology that did not make sense due to their technological limitations (weight and range) and their costs. It was, however, predicted that the automaker that succeeds in creating a mass market for electric vehicles will be the one that eliminates the battery bottleneck (Christensen 1997). Tesla (founded in 2003) can hence be considered a disruptor as the company's development of lithium-ion battery technology has been instrumental in producing vehicles with an acceptable range for modern consumers. As a result, the mass market for electric vehicles has emerged and experienced rapid growth. Tesla has a significant first-mover advantage as a company that entered an emerging market created by a disruptive technology early on, while market leaders are often unable to develop or adopt disruptive technologies due to their entrenched processes and fixed values that do not fit the new target market.

*Appendix 3:* ***Different optimal innovation ratios for different firms***

The optimal innovation ratio varies across industries. Industrial companies come closest to the 70-20-10 ratio, while technology companies spend less time and money on improving their core product because their market demands new product releases. Consumer product manufacturers, on the other hand, are less active at the transformation level, focusing mainly on incremental innovation. The competitive position also influences a company's optimal innovation ratio. Thus, a lagging company is more likely to pursue riskier transformational innovations as it seeks to create a truly breakthrough product that has the potential to change its growth curve, while a market leader may decide to remove some risk from its portfolio by focusing more on core initiatives. The third factor, a company's stage of development, also affects the appropriate balance of the innovation portfolio. While early-stage companies need to invest in transformative innovations to attract investors and customers and because they do not yet have a core business to build on, more mature companies have established a stable customer base and want to protect and grow their core business (Day 2007).

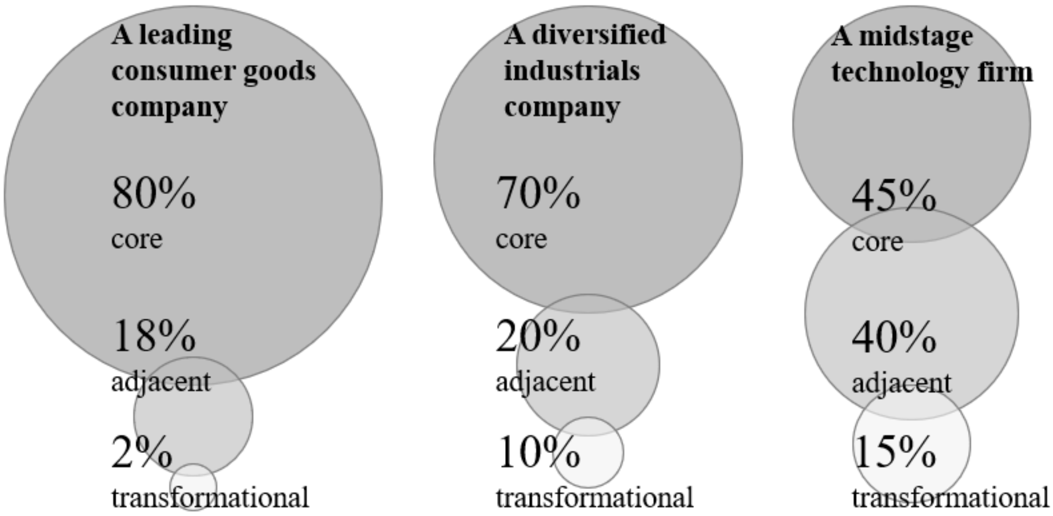


*Figure 3: Innovation ratios. (Nagji and Tuff 2012).*

*Appendix 4:* ***Status quo innovation ambition***

This classification was subsequently confirmed by the top management of the subsidiary.

*Core*

Most of the innovation activities at the subsidiary can be classified as CI in the form of continuous improvements within the product teams, serving existing customers[15] with existing products.

*Adjacent*

[15] Customers here refers to the end consumer

Additionally, the subsidiary adds incremental products to their portfolio. An example product presents a solution to an end-user problem whose idea was tested for technical feasibility and consolidated in an internal code camp[16] with experts from different teams. Based on its promising potential and its manageable implementation effort, as well as due to the positive feedback from stakeholders at the parent company, the product was finally developed from within the subsidiary.

*Transformational*

One example that changed the production within the OEM is the product *"smarT"*[17]. Using Machine Learning, the product intended to reduce a source of errors in production and increase the quality of the vehicles produced. The product is based on a prototype presented in a company-external research campus and innovation platform for mobility and the production of the future. As part of an incubator program, the idea was developed into a product the subsidiary in collaboration with the respective innovation platform team. Finally, the subsidiary's product team took the prototype from the campus and independently developed it into an industrially applicable product. In terms of the *how to win* dimension of this framework, this new product can be classified as transformational; it remains to be seen whether it serves new customers through new opportunities in production.

*Appendix 5:* ***Overview interviewees***

For data protection reasons, the name of the subsidiary as well as names of the interviewees are anonymized. The interviewees are referred to as I1, I2, etc. as pseudonyms.

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[16] Code camps, code fests, or hackathons are practical events for the collaborative solving of business problems and real-world challenges.

[17] Name changed due to anonymity reasons

| Alias | Name | Company | Role | Expert for |
|---|---|---|---|---|
| I1 | Anonymous | The subsidiary | Project Management Office | Project Management |
| I2 | Anonymous | The subsidiary | Co-Lead Product-Innovation Initiative | Product orientation |
| I3 | Anonymous | The subsidiary | Lead Expert Software Excellence | SAFe, Software Development, Management |
| I4 | Anonymous | The subsidiary | Team Lead | Management, Project management |
| I5 | Anonymous | The subsidiary | Business Unit Lead Strategy, Transformation & Growth | Strategy & Innovation |
| I6 | Anonymous | The subsidiary | Business Unit Lead Autonomous Systems | Management, Innovation, Production Automation |
| I7 | Anonymous | The subsidiary | Business Unit Controller | Controlling |
| I8 | Anonymous | The subsidiary | Team Lead | Management, Project management |
| I9 | Anonymous | The subsidiary | Business Unit Lead Car Sales Operations | Management |
| I10 | Anonymous | Etribes Connect GmbH<br><br>(a digital consultancy based in Hamburg, Germany) | Principal Venture Building | Corporate Venturing & Venture Building, Digital Transformation |
| I11 | Anonymous | The subsidiary | In-house Strategy & Innovation Coach | Strategy & Innovation |
| I12 | Anonymous | The subsidiary | CEO | Management, Corporate Governance |

*Figure 4: Interviewee overview.*

*Appendix 6:* ***Qualitative content analysis of qualitative interviews***

*Category 1: Imperative for innovation*

*Subcategory 1.1: Innovation at an established organization*

In this subcategory, the results of the interviews are evaluated with regard to the importance of innovations for established companies. I10 and I5 emphasize the need for established organizations to innovate; I10 calls it an "imperative" to secure the company's future viability and to be able to respond to changing customer needs and rapidly developing trends and technologies.

*Subcategory 1.2: Innovation contribution from a subsidiary*

In the case of a subsidiary, the need to contribute to the parent company's corporate innovation depends, in I10's view, on the purpose of the subsidiary. The purpose must be determined together with the parent company. However, the parent company should be interested in the subsidiary contributing to the parent company's corporate innovation. I10, I2, and I5 emphasize that it would be a missed opportunity not to involve the people with expert know-how and knowledge about the organization's requirements from the subsidiary.

*Category 2: Competitiveness*

*Subcategory 2.1: Competitiveness as an employer*

This subcategory analyzes the importance of innovations within a company with regard to employer branding. I2 emphasizes that it is important for the attractiveness of an employer to create opportunities to make a difference as an employee and to make a meaningful contribution to the health of the company. I2 and I10, therefore, advise again to let e.g., developers contribute their perspective and experience.

*Subcategory 2.2: Competitiveness as a software developing subsidiary*

According to I10, I5, and I2, a software development company is interchangeable if it is limited to casting a solution in software. I10 points out that a German software development company in particular is usually not that competitive when it comes to the costs for the contracting organization. These arguments are strengthened by I1 who states that a competitive advantage among software developers is deep insights into the processes of the contracting organization. I1 points out that specific knowledge is critical in today's IT world and that it is important to see systems in context. A software development company that has this knowledge should therefore be involved in and enabled for innovation activities.

*Category 3: Innovation prerequisites*

*Subcategory 3.1: CI and AI prerequisites*

This subcategory examines the conversations with regard to the prerequisites of the core and adjacent innovation. I10, I6, I11, and I9 stress that these are rather close to the core business and must as well take place in a close context, e.g., within the projects. In I6’s view, the subsidiary needs to innovate in the domains its people have expertise in. I10, I2, I3, I4, and I8 agree that a prerequisite for this is the involvement of the relevant functions to find optimal and innovative solutions. According to I10, I2 and I8 the involvement should take place early in the process to prevent friction at the handoff point between solution definition and handover to the service provider and to create an impetus for innovation within the teams. Another aspect mentioned by I5 is the framework conditions required for the success of an innovation. Even smaller and more incremental initiatives must be managed with a view to validating the benefits for users and the economic benefits, so as not to delve too deeply into topics that have no such potential.

*Subcategory 3.2: TI prerequisites*

I10 notes that for TI, teams do not need to be as close to the existing company as for CI and AI, but strategically should remain relatively close to solving relevant problems and secure commitment and buy-in from the parent company. To achieve this, according to I5, it is crucial to show the parent company that it can save or earn money with the innovation. As suggested by I11, engagement of the employees as innovators can in turn be fostered through metered funding from management as an equipped sponsor. Additional to a centrally managed budget proposed by I9, I6 and I10 point out that it also needs more autonomy and room to maneuver, as well as a clear purpose. I5 stresses that the latter needs to be done in a targeted way to not promote too many less innovative products. However, I7 and I12 argue that the investments needed for TI cannot be stemmed within the P&L of the subsidiary's business. I12 therefore sees the TI dimension within the subsidiary limited to idea creation and as a next step collaboration with the parent company on the realization. I11, therefore, brings in a central innovation management that can act as an enabler.

*Category 4: Business model impact*

*Subcategory 4.1: Limitations and opportunities with regard to economic dependence*

This subcategory analyzes the impact of the business model on innovation in the case of the subsidiary in terms of economic dependence on the parent company. As I7 notes, the setup of a wholly owned subsidiary with a profit and loss transfer agreement entails particularities in terms of liquidity and restricts the subsidiary in its savings for investments (in innovation). 95% of the subsidiary's sales are person-hours that are sold to the group. Due to taxation reasons for transfer pricing, the company must comply with prescribed margins and calculate based on these. Compared to other innovative companies that generate high margins on the free market, the subsidiary with its direct customers within the parent company is constrained by margin restrictions. According to I8 and I7, it therefore cannot easily achieve an ROI on its innovation investments, nor do these innovations become a cash cow quickly, which implies an even higher risk for the subsidiary. For I5, being a subsidiary of an established OEM means an advantage, as this setup also provides financial security. As for the management of available resources, I5 stresses that they need to be used in a targeted manner and focus on truly innovative products. However, I7 and I12 emphasize that high investments needed for TI cannot be stemmed by the subsidiary alone.

*Subcategory 4.2: Limitations and opportunities in the collaboration with the parent* *organization*

The subsidiary is commissioned with digital products and software solutions by the parent organization. For the implementation, the subsidiary is organized in a decentralized manner and divided into agile product teams with a product owner, software developers, a scrum master, etc., and a product manager from the parent company. According to the responses of I11, I5, I3, I2, I4, I9, and I8, the goal of the subsidiary, however, is not to be a pure vicarious agent. I10 and I1 support this position by pointing out the competitiveness (see C2) and the untapped potential of a subsidiary's technological and solution-oriented employee competence in these circumstances. Therefore, I3 and I8 agree that in addition to preparing and defining the strategic framework, the entire implementation should be shaped by the subsidiary. All concur that the product teams should hence be involved much earlier. By assigning the task of finding solutions to the respective person with the appropriate skills, a sense of ownership is created for them. In this context, I4 believes that empowering these teams to develop innovation capabilities requires leveraging the deeper insights of the subsidiary and seeking a two-way partnership with the parent organization. I5 points out that the subsidiary needs to be more convincing to be integrated and that its goal should be to be approached by the parent organization and to be the first point of contact for innovation and technology. I12 also mentions that the subsidiary needs to be integrated in the early phases of the process and should seek a participation together with the parent organization for the creation of TI, as the subsidiary cannot stem TI investments alone.

| Main category 1: Imperative for Innovation | | | |
|---|---|---|---|
| Subcategory | Definition | Examples | Coding |
| C1.1 Innovation at an established organization | Evaluation of the need for established companies to | "[…] it is imperative that they develop additional sources of revenue and additional business models for future viability."(I10) | Established companies face the need to innovate to secure their |

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|---|---|---|---|
| | innovate | "[…] secure their future viability through corporate innovation." (I10)<br><br>"[…]there are great examples that have gone down the drain with a very good business because they did not question their positioning." (I5) | future viability. |
| C1.2 Innovation contribution from a subsidiary | Evaluation of the need for subsidiaries to contribute to corporate innovation | "That is […] a question about the purpose of the company" (I10)<br><br>"I have to be clear about whether I want to use this vehicle to promote outside-in innovation or inside-out innovation, whether I want to achieve a strategic goal or a financial goal" (I5)<br><br>"[the product orientation initiative] was not thought up in isolation at [the subsidiary] I but comes in its original form from [the OEM] itself."(I2)<br><br>"We have an extremely high level of knowledge about how processes work in the group, how software is supposed to get into the vehicle, what safety levels there are, and so on. That means we can do more than just be implementers" (I5)<br><br>"There are three pillars on which we must build" (I5) | Whether to contribute to the corporate innovation of the parent company is a question about the purpose of the subsidiary. However, the potential of a subsidiary to contribute to corporate innovation should not be wasted. |
| Main category 2: Competitiveness | | | |
| Subcategory | Definition | Examples | Coding |
| C2.1 Competitiveness as an employer | How to be an attractive employer to target employees | " […] a need for employees and workers in the labor market to engage and do meaningful things that have a positive impact. This is also a unique selling point for us as a company." (I2) | The possibility to engage and contribute value to the company is important to target employees. |
| C2.2 Competitiveness | Competition with other | "[…] there are many interchangeable companies that simply cast a solution in | When only being an |

| | | | |
|---|---|---|---|
| as a software developing subsidiary | companies that build software | software.” (I2)<br><br>“[…] the parent company could just as easily commission any other service provider to develop the software.”(I10)<br><br>“Firstly, 98% of our locations are in Germany; if I am only looking for an implementer, then I will go to a low-cost country where I am looking for people who will only implement for me.”(I5) | implementer, a subsidiary is interchangeable. |
| Main category 3: Innovation prerequisites | | | |
| Subcategory | Definition | Examples | Coding |
| C3.1<br>CI and AI prerequisites | Prerequisites for CI and AI within subsidiaries | “I would also involve the people who are developing at the top of the process”(I10)<br><br>“I believe that the impetus [for innovation] comes when people are involved in the whole design process” (I2)<br><br>“So, if the ideas are rather close to the core business of the company and have a high degree of dependency, then there is no reason to spin them off” (I10)<br><br>“[…] we can continue to pursue the smaller innovations in the business units. As a company, we must be able to afford to delve into these topics.” (I5) | Involvement in the processes is a prerequisite to fostering CI and AI within subsidiaries. Also, framework conditions are needed to validate the user benefit and the economic benefit. |
| C3.2<br>TI prerequisites | Prerequisites for TI within subsidiaries | “The more radical the problems, the further these teams can move away from their core business to truly have full autonomy and freedom.”(I10)<br><br>“[…] there is often the problem that there is no clear approval from the management level and no clear strategy”(I10) | Autonomy as well as parent company approval and commitment and alignment with overall strategy are prerequisites for |

| | | | |
|---|---|---|---|
| | | "You probably couldn't solve the problems that the core business would have liked to have solved because you were too far away from them strategically"(I10)<br><br>"The problem is that when you invest a lot in future topics, you always need a commitment from the group and seed capital" (I7)<br><br>"I think these can either come from the individual teams, or they are topics where it is decided to actively invest in technologies or a business innovation because we believe that this will be the game changer in one or two years" (I5)<br><br>"We have to be able to show the parent company that it can save or earn money with the technology" (I5) | TI in subsidiaries. |
| Main category 4: Business model impact | | | |
| Subcategory | Definition | Examples | Coding |
| C4.1 Economic dependence | Limitations and opportunities resulting from the economic dependency on the parent company. | "We are a 100% subsidiary with a profit transfer agreement, which of course implies peculiarities in terms of liquidity"(I7)<br><br>"In good times, you can't really put anything aside for investment"(I7)<br><br>"[…] or is your customer in the corporate environment, where you are also only allowed to operate within the special margin framework."(I7)<br><br>"I see this as a great opportunity because we will never be short of money." (I5)<br><br>"I think we have enough money in the | The economic dependence that comes with a wholly owned subsidiary can result in limitations with regard to innovation investments. However, when the provided funds are managed well, a subsidiary status can also provide safety. |

| | | | |
|---|---|---|---|
| | | system to create the innovations. If we then get it to the surface because it's a great innovation and we've invested a lot in it, then the parent company promotes it as well. We just have to pitch it well. So, I see that as mostly an advantage, not a disadvantage.” (I5)<br><br>“[…] we have sufficient resources in hand to drive innovation. We just have to do it in a targeted and focused way” (I5)<br><br>“If we want to scale a great innovation that we believe in, we need to focus and stop promoting so many less innovative products. That's where we need the commitment.” (I5)<br><br>“TI also involve very high investments, which are necessary. As a subsidiary, we will never be able to shoulder these high costs on our own” (I12) | |
| C4.2 Collaboration with the parent organization | Limitations and opportunities with regard to collaboration with the parent organization. | “[The subsidiary is] only commissioned to cast the solution into the software” (I2)<br><br>“[…] then you automatically close yourself off to all the possibilities that a technologically oriented colleague could think of to better solve this problem” (I10)<br><br>“I believe that we can integrate. We just have to be more convincing. However, we compete alongside all external partners and pitch and hope to win. Instead, our goal should be for the parent company to approach us.” (I5)<br><br>“[The parent company] approaching us | The subsidiary needs to be more involved in the overall solution development process and be the first point of contact for innovation and technology. |

| | | | |
|---|---|---|---|
| | | with an idea and based on our footprint and track record asking us if we would like to participate proactively" (I12) | |

*Figure 5: Coding guide.*

*Appendix 7:* ***SWOT analysis: Innovation contribution from the subsidiary***

| Strengths | Weaknesses |
|---|---|
| - Being a separate entity with agile organizational structures<br>- Having expert know-how internally<br>- Having deep insights into the products and processes of the parent company<br>- Having economic safety provided by the parent company | - Currently not being perceived as an innovation driver<br>- Having no focused innovation portfolio<br>- Being limited in liquidity due to profit and loss transfer agreement<br>- Being limited in ROI due to margin restrictions<br>- Relying on parent company as (almost) only customer<br>- Not being truly integrated in solution definition processes<br>- Not being the first point of contact for innovation and technology |
| **Opportunities and levers** | **Threats** |
| - Increasing internal awareness of the situation<br>- Initiatives intending process integration and earlier involvement<br>- Having possibility to exit projects with no more potential<br>- Having the potential to allocate resources in a targeted manner<br>- Aiming to prove that the subsidiary has innovation and tech in its DNA<br>- Initiatives intending to foster transformational innovation<br>- Having the potential to integrate more customer insights and know-how | - Adapting implementer role<br>- Receiving competition from other software developing companies (especially offshore) |

*Figure 6: SWOT analysis.*