Shifting Gears: German OEMs and the Rise of Non-Automotive Competitors

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Abstract

This dissertation examines the competitive dynamics between German Original Equipment Manufacturers (OEMs) and non-automotive entrants in the evolving global automotive market. As the automotive industry undergoes a period of significant transformation, driven by the adoption of electric vehicles, digital technologies, and autonomous driving, new non-automotive entrants are leveraging their expertise in software, artificial intelligence, and consumer electronics to challenge the established positions of German OEMs.

This research applied a mixed-methods approach, combining qualitative insights from expert interviews and quantitative data from a consumer survey, with the objective of identifying the factors that enable German OEMs to remain competitive. The analysis identified engineering excellence, brand reputation, and premium market leadership as the key strengths of the German automotive industry, while also highlighting significant challenges, including slow innovation cycles, high costs, and skills gaps. Non-automotive entrants demonstrate superior cost competitiveness, agile supply chains, and customer-centric innovations, which collectively present a significant challenge to traditional OEMs.

The findings emphasize the importance of dynamic capabilities, customer-focused innovation, and cost-efficient strategies for German OEMs to maintain competitiveness. The results of this research provide valuable insights for industry stakeholders, underscoring the need for adaptability and collaboration in a rapidly transforming market landscape.

Keywords: German OEMs, non-automotive entrants, automotive transformation, dynamic capabilities, perceived value model, market competitiveness

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Sumário

Esta dissertação analisa as dinâmicas competitivas entre os fabricantes alemães de veículos (OEMs) e novos concorrentes não automotivos no mercado automotivo global em transformação. A indústria automotiva passa por uma transformação significativa, impulsionada pela adoção de veículos elétricos, tecnologias digitais e condução autônoma. Novos entrantes não automotivos utilizam sua experiência em software, inteligência artificial e eletrônicos de consumo para desafiar as posições consolidadas dos OEMs alemães.

O estudo adota uma abordagem de métodos mistos, combinando insights qualitativos de entrevistas com especialistas e dados quantitativos de uma pesquisa com consumidores. A análise identifica a excelência em engenharia, a reputação da marca e a liderança no mercado premium como os principais pontos fortes da indústria automotiva alemã, mas também ressalta desafios significativos, incluindo ciclos lentos de inovação, altos custos e lacunas de habilidades. Os novos concorrentes não automotivos demonstram maior competitividade de custos, cadeias de suprimentos ágeis e inovações centradas no cliente, representando um desafio relevante para os OEMs tradicionais.

Os resultados destacam a importância de capacidades dinâmicas, inovação orientada ao cliente e estratégias de custo eficientes para que os OEMs alemães mantenham sua competitividade. Este estudo oferece insights valiosos para os stakeholders da indústria, sublinhando a necessidade de adaptabilidade e colaboração em um mercado em rápida transformação.

Palavras-chave: OEMs alemães, concorrentes não automotivos, transformação automotiva, capacidades dinâmicas, competitividade de mercado

Título: Mudando de Marcha: OEMs Alemães e a Ascensão de Concorrentes Não Automotivos

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List of Abbreviations

AI	Artificial Intelligence
BEV	Battery electric vehicle
EV	Electric vehicle
FCEV	Fuel cell electric vehicle
HEV	Hybrid electric vehicle
ICEV	Internal combustion engine vehicle
kWh	Kilowatt-hour
PHEV	Plug-in hybrid electric vehicle
OEM	Original Equipment Manufacturer
RBV	Resource-Based View
RBT	Resource-Based Theory
SCA	Sustained Competitive Advantage
SSI	Semi-structured interview
WTB	Willingness to Buy

1. Introduction

The German automotive industry has long been acknowledged as a fundamental pillar of the country's economy and a global leader in vehicle manufacturing. Frequently characterized as the "backbone industry of Germany" (Germany Trade & Invest, 2022, p. 2) and a "global export powerhouse" (Germany Trade & Invest, 2022, p. 3), this sector has consistently demonstrated remarkable resilience over the years. In 2023, Germany produced over 4.12 million passenger cars (Statista Research Department, 2024a), thereby confirming its position as the fourth-largest producer globally (Statista Research Department, 2024b). The dominance of the German automotive industry is further evidenced by leading positions held by companies such as Volkswagen, BMW, and Mercedes-Benz. These companies have established themselves as industry leaders not only due to their production capabilities but also through their extensive supplier networks and cutting-edge research and development initiatives (Germany Trade & Invest, 2022).

Nevertheless, the industry is currently undergoing a substantial transformation. The tightening of emissions regulations, the shift towards electric vehicles (EVs), and the rise of autonomous driving technologies are collectively reshaping the competitive landscape. Concurrently, non-automotive companies are entering the market. Companies such as Xiaomi, Sony, and Huawei, renowned for their proficiency in electronics, artificial intelligence (AI), and software integration, are capitalizing on their technological expertise to introduce novel vehicles (Felser & Wynn, 2023).

The competitive landscape between established German Original Equipment Manufacturers (OEMs) and these new market entrants gives rise to crucial considerations regarding the future of the automotive industry. As the automotive industry transitions towards greater electrification, autonomous driving and alternative ownership models, traditional automakers must rethink their strategies in order to maintain their position as market leaders (Burr, 2024). Therefore, it is crucial to comprehend how German OEMs can optimally leverage their resources and capabilities while adapting to innovations introduced by non-automotive entrants.

Therefore, this study is guided by the following research question:

RQ: What factors are enabling German OEMs to compete with non-automotive entrants in the global automotive market?

Given the broad nature of the term “vehicles”, it is essential to establish clear definitions to ensure that the parameters of this research are clearly delineated and understood. In the automotive sector, vehicles are classified according to their functions and the regulatory frameworks that apply to them. The principal categories within the European Union are Category M, which encompasses vehicles designed for the transportation of passengers, and Category N, which includes vehicles intended for the conveyance of goods. These categories were further subdivided into light-duty vehicles, such as passenger cars and vans, and heavy-duty vehicles, which include trucks, buses, and coaches. Furthermore, there are additional categories, such as Category L for two- and three-wheeled vehicles and Category T for agricultural and forestry tractors (European Commission, n.d.). This study focused specifically on passenger cars. This focus is justified by the fact that in 2023, German OEMs produced 4.12 million passenger cars, compared to only 190,000 trucks, emphasizing the dominant role of passenger cars in the country’s automotive industry (Statista Research Department, 2024c).

This research applied a mixed-methods approach, combining qualitative and quantitative data to analyze the competitive landscape. A consumer survey based on Monroe and Krishnan’s (1985) Perceived Value Model examined the relationship between factors such as brand perception, price, quality and sacrifice and their impact on consumer purchase intention. The study also examined perceived risk, focusing on the role of trust and technical competence. The aim was to understand how perceived quality and sacrifice influence perceived value and ultimately consumer purchase intention. In addition to the consumer survey, semi-structured interviews with experts were conducted to gather insights from industry professionals. The experts were selected based on their qualifications, seniority, and specialization, allowing for a diverse range of perspectives. The qualitative findings from the interviews, together with the quantitative data from the survey, were combined with existing literature to ensure a comprehensive analysis.

The last section contains a conclusion with practical recommendations for management, suggestions for future research and a discussion of the limitations of this study.

2. Literature Review

2.1 The Automotive Industry in Germany

The German automotive industry is often characterized as the "backbone industry in Germany", "Europe's leading market", or "global export powerhouse" (Germany Trade & Invest, 2022, pp. 2–3). These terms illustrate the significance of this industry not only within Germany but also on the global stage. The following sections will examine the structure and dynamics of this key industry to gain insight into the factors that contribute to its global leadership and resilience. In order to provide a theoretical framework for this analysis, the Resource-Based Theory will be presented and applied to examine the resources and capabilities of the German automotive industry.

2.1.1 An Industry Overview

In 2023, the German automobile industry produced 4.12 million passenger cars, thereby constituting a principal pillar of the German economy (Statista Research Department, 2024a). Furthermore, this makes Germany the world's fourth largest producer of passenger cars, behind China, Japan and India (Statista Research Department, 2024b). When commercial vehicles are included, Germany remains sixth largest producer, behind the United States of America and South Korea (Statista Research Department, 2024d).

The automotive industry generated the highest revenues in Germany, followed by mechanical engineering industry, the chemical-pharmaceutical industry and the electrical engineering industry (Statista Research Department, 2024e). The total turnover in 2023 was approximately €207.3 billion, comprising new car sales (€66.6 billion), used car sales via brand dealership (€58.4 billion), service (€33.8 billion), used car sales by independent dealers (€32.3 billion), new truck sales (€10.2 billion) and used truck sales (€6.1 billion) (Statista Research Department, 2024f). As described in the beginning, the key focus of the following analysis will be on passenger cars.

By exporting approximately 2.95 million passenger cars and generating €393 billion in foreign market revenue in 2023, German automotive companies reinforced their role as a key economic force in the global economy (Statista Research Department, 2024a). The European market remained the primary recipient of German automotive exports, with 1.78 million passenger cars exported, followed by 0.57 million cars to Asia and 0.51 million cars to North and South America (Statista Research Department, 2024a).

The three largest OEMs in Germany are the Volkswagen Group, which reported revenue of approximately €322.28 billion in 2023 (Volkswagen Group, 2024), the BMW Group with €155.5 billion in 2023 (BMW Group, 2024), and the Mercedes-Benz Group with €153.2 billion in 2023 (Mercedes-Benz Group AG, 2024a). However, the strength of Germany's automotive industry is not only reflected in the dominance of its leading OEMs but also in the German automotive supplier ecosystem distinguished by its heterogeneity (Germany Trade & Invest, 2022). The industry includes a diverse set of businesses, spanning from large manufacturers and system providers to specialized Tier-2 and Tier-3 suppliers, with 85% of these companies classified as medium-sized (Germany Trade & Invest, 2022). Global entities such as the Bosch Group, the world's largest automotive supplier with revenues of €91.6 billion in 2023 (Bosch Group, 2024), play a prominent role in establishing and sustaining this ecosystem.

2.1.2 Market-Based and Resource-Based Perspectives

A multitude of factors can affect the performance of a firm. Such factors may be directly associated with the characteristics of the firm itself, or indirectly impact the firm through its external business environment (Falciola et al., 2020).

The Market-Based View holds that a firm's performance is primarily influenced by external industry factors and competitive dynamics (Wang, 2014). Bain's (1951) Structure-Conduct-Performance (SCP) framework suggests that market structure shapes firm behavior, affecting overall performance. Porter (1981) built on this with his Five Forces model, identifying key external factors that the firm needs to manage to compete in an industry (Boru & Kuhil, 2018). Both frameworks are rooted in the Industrial Organization economics phase, focusing on the firm's external environment (Wang, 2014).

From the 1980s, strategic thinking shifted toward firm-specific resources and capabilities (Furrer et al., 2008). Penrose (1959) emphasized organizational resources, later expanded by Barney (1991) in the Resource-Based View (RBV), which identifies resources and competencies as key to Sustained Competitive Advantage (SCA). The term Resource-Based Theory (RBT) is now used to reflect its development into a comprehensive theory (Barney et al., 2011; Kozlenkova et al., 2014). Accordingly, the term RBT is used hereinafter to define the theoretical framework.

Firm resources can be classified into three main categories: physical capital (equipment, raw material, location, technology), human capital (employee skills, experience, relationships) and organizational capital (the firm's structure, systems, processes) (Barney, 1991). In accordance

with the two fundamental assumptions of RBT, these resources may vary even when firms operate within the same industry (Peteraf & Barney, 2003). Additionally, some firms may possess superior capabilities in certain activities due to the distinctive resources they have at their disposal (Peteraf & Barney, 2003).

In order for the resources mentioned to generate a SCA, they must fulfill the following four conditions ("VRIO"): Firstly, a resource must be ***v****aluable*, meaning it helps reduce costs or increase revenues. Secondly, it must be ***r****are*, meaning few firms possess it. Thirdly, it must be ***i****mperfectly imitable*, meaning it is costly or difficult for competitors to replicate. Finally, it must also be effectively exploited by the firm's ***o****rganization* through proper processes and systems (Barney & Hesterly, 2015).

However, the statement by D'Aveni et al. (2010) that the RBT is "rooted in a conception of the world that is essentially stable" (p.1374) represents the primary critique of the RBT theory. Teece et al. (1997) responded to this criticism by expanding the RBT with the dynamic capabilities framework. While the RBT is considered as inadequate for explaining success in rapidly changing environments, the dynamic capabilities framework addresses this shortcoming by explaining how firms can adapt, innovate, and reconfigure their resources to maintain a SCA in evolving market conditions (Barreto, 2010). The concept of dynamic capabilities will be further explored in Chapter 2.2.2, in which its specific role and relevance for the automotive industry will be evaluated.

2.1.3 Key Resources of the German Automotive Industry

In light of the aforementioned theoretical perspectives, the German automotive industry serves as an illustrative example of the interplay between diverse resources. The following section will examine the principal resources that serve to reinforce the competitive advantage of the German automotive industry.

Germany hosts a multitude of OEMs, including global industry leaders such as Volkswagen, BMW, and Mercedes Benz. Additionally, it boasts a vast network of OEM suppliers, with 15 of the global top 75 automotive suppliers (Germany Trade & Invest, 2022). Building on the principles of RBT, these resources of the German automotive industry not only contribute to the industry's competitive advantage, but also underscore the distinctive strengths that empower the German automotive sector to stand out in the global market.

Physical capital. In comparison to other European countries, Germany is unique in its concentration of research and development (R&D), design, supply, manufacturing, and assembly facilities within the automotive sector (Germany Trade & Invest, 2022). Besides Bavaria (BMW and Audi), or the Wolfsburg cluster (Volkswagen), the Baden-Württemberg region is a major automotive industry cluster in Germany, home to leading companies such as Mercedes-Benz, Porsche, Bosch (electronics and engineering), Carl Zeiss (optical), and SAP SE (software and information technology) (Zhi, 2024). Consequently, German OEMs are able to benefit from a diverse and extensive network of suppliers, including small and medium-sized companies, as well as a multitude of Tier-2 and 3 suppliers (Germany Trade & Invest, 2022).

Human capital. German automotive OEMs combine a highly skilled workforce with a leadership position in R&D. Germany's automotive companies have the highest number of research personnel within the manufacturing sector, representing approximately one quarter of the total R&D workforce in the country's private economy (Germany Trade & Invest, 2022). Moreover, German automotive firms are well-represented on the global stage in terms of their human capital, particularly in domains such as engineering and education, including postgraduate and doctoral programs. (Czernich et al., 2021).

Organizational capital. With an R&D investment of €106.6 billion in 2022, Germany's R&D efforts witnessed a notable expansion compared to 2021 (+€13.2 billion), making it the number one R&D investor in Europe, with half (51%) of this increase coming from companies in the automotive sector (European Commission: Joint Research Centre, 2023). German automotive companies invested nearly €52.4 billion in 2022 in internal R&D projects, thereby exceeding all other domestic manufacturing sectors (European Commission: Joint Research Centre, 2023).

2.2 The Transformation in the Automotive Industry

Tightening emissions regulations for internal combustion engine vehicles (ICEVs) are driving the automotive industry towards electrification and digitalization (Yeung, 2024). Furthermore, the transition to EVs is fostering the emergence of new players in the automotive supply chain, including companies with no prior involvement in the industry (Inverto, a BCG company, 2024). In certain market segments, OEMs enjoy considerable competitive advantages vis-à-vis new market entrants, whereas in other areas, the agility and flexibility of these new entrants can offer distinct competitive benefits (Deloitte, 2019).

The following sections will present the major challenges currently faced by the automotive industry, identifying the key megatrends driving its transformation and highlighting the influence of non-automotive entrants.

2.2.1 The Role of Software-Defined Vehicles and Non-Automotive Entrants

The automotive industry is currently facing three significant disruptive forces that are unparalleled in both their scale and impact: EVs, autonomous driving and new ownership models (Inverto, a BCG company, 2024).

EVs include battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), hybrid electric vehicles (HEVs) and fuel cell electric vehicles (FCEVs). BEVs are entirely powered by electricity, utilizing rechargeable battery packs, whereas PHEVs and HEVs integrate an electric motor and battery with a smaller internal combustion engine. FCEVs utilize hydrogen fuel cells to generate electricity (Gaton, 2018). An autonomous vehicle, also referred to as self-driving car, is characterized by its "ability to sense its surrounding environment and navigate safely with little or no human input" (Zhang et al., 2023, p. 146). The levels of autonomous driving range from level 0, where the driver has full control, to level 5, which represents full automation, and thus places the vehicle in complete control without human intervention (Wienrich, 2022). The third megatrend, shared mobility, encompasses the temporary sharing of various transportation modes, including vehicles and bicycles, thereby enabling users to access theses services as required. Examples include ride-hailing apps such as Uber, short-term vehicle rentals such as Lime, and delivery services such as UberEATS (Shaheen et al., 2020).

The three aforementioned megatrends are combined in the software-defined vehicle (SDV), which refers to a stage where the amount and value of software, along with electronic hardware, in a vehicle surpasses that of its mechanical components (Deloitte, 2021). The vehicle's sophisticated computing capabilities facilitate the integration of AI algorithms, thereby enabling highly automated and autonomous driving. Furthermore, SDVs facilitate the emergence of novel business models, shifting the emphasis from the ownership of individual vehicles to the provision of convenient access to mobility services (Neemann, 2023).

As these megatrends continue to evolve, a growing number of new companies are entering the automotive industry and occupying every niche of what appears to be the emerging dominant model: shared, digital, and autonomous EVs. These developments are having a profound impact on the sector's core dynamics. Traditional automakers are competing with tech giants

and startups to secure control over future automotive technologies (Ferràs-Hernández et al., 2017).

One illustrative case is Xiaomi. Primarily renowned for its intelligent hardware and electronic products, Xiaomi has diversified its business activities by entering the automotive sector. Its car, the SU7, showcases technological advancements, including autonomous driving capabilities, exemplifying Xiaomi's competitive advantage. Furthermore, Xiaomi's proficiency in smartphones and AI has established a robust foundation for its venture into smart cars (Li, 2024).

Similarly, Sony, a prominent entity within the consumer electronics industry, is also striving to enhance the mobility experience by establishing an operating company, designated as "Sony Mobility Inc.". The initiative is intended to explore potential opportunities within the EV market. Notably, Sony has already developed two prototypes, the VISION-S 01 and the VISION-S 02, both currently undergoing testing (Sony, 2022).

In December 2023, smartphone manufacturer Huawei unveiled the AITO M9, a full-size luxury SUV developed with Chinese car manufacturer Seres under the auspices of the Harmony Intelligent Mobility Alliance (HIMA). Although not a conventional brand, HIMA brings together a consortium of partners under the guidance of Huawei. Huawei's contributions to the alliance encompass intelligent cockpit and driving solutions, in addition to providing support in design and sales (Andrews, 2024).

2.2.2 Adapting to Innovation: The Role of Dynamic Capabilities

The transition towards software-driven innovation is central to the three major disruptive forces currently reshaping the automotive industry. Following an analysis of 60 definitions from a range of disciplines including business, economics, technology and management, Baregheh et al. (2009) propose to define innovation as "the multi-stage process whereby organizations transform ideas into new/improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (p. 1334).

However, the successful management of innovation in fast-moving industries requires more than just idea generation. The challenge for organizations lies in the fast-moving, *dynamic* nature of industries, where firms must be agile and responsive to changes, including those related to new technologies, shifts in markets, and emergence of new competitors (D. Teece & Pisano, 1994). To address these challenges, firms must possess the necessary *capabilities*,

meaning managerial and organizational skills that enable continuous improvement, coordination and reallocation of resources (D. Teece & Pisano, 1994). In consideration of existing definitions of dynamic capabilities and the potential for a definition that is either too vague or intractable, Barreto (2010) summarizes dynamic capabilities as follows: "A dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource-base" (p.271).

Building on Barreto's definition of dynamic capabilities, they can be broken down into three interrelated processes: sensing opportunities, seizing opportunities, and transforming resources to manage threats (Teece, 2007). A firm's capacity to respond effectively to a changing business environment is significantly influenced by its sensing capabilities, which is its ability to identify and interpret changes in the external environment (Durán & Aguado, 2022). Once identified, firms with robust seizing capabilities can innovate and capitalize on them (Teece, 2007). Transforming refers to a "continuous strategic alignment and realignment of tangible and intangible resources as markets evolve" (Santa-Maria et al., 2022, p. 1310).

In addition to dynamic capabilities, the concept of innovation capabilities is linked to our theme, particularly when analyzing how firms adapt and succeed in rapid changing environments (Aas & Breunig, 2017). Innovation capability refers to the "the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm and its stakeholders" (Lawson & Samson, 2001, p. 384).

An illustrative example of this necessity for adaptability is the German automotive industry, which is currently undergoing a period of significant transformation, driven by rapid technological advancements, digitalization, and evolving consumer expectations. The development of new resources such as software, data analytics and cybersecurity is becoming increasingly crucial (Felser & Wynn, 2023). However, the industry's tendency to outsource its information technology functions has resulted in a deficit knowledge and many companies "have failed to develop expertise in key knowledge areas and lack even some core IT competencies" (Felser & Wynn, 2023, p. 183). The traditional competitive advantages of German OEMs in mechanical engineering will no longer be sufficient in the context of the growing significance of software technologies (Burr, 2024).

2.3 The Transformation of the German Automotive Landscape

In light of the preceding discussion regarding the automotive transformation, we can reasonably assert that the German automotive industry is undergoing a significant transition as it adopts electrification and advanced technologies. The following chapter examines the growth of the EV market in Germany, identifying the principal factors that are influencing this evolution. By analyzing the current strategies of major automotive manufactures Volkswagen, BMW, and Mercedes-Benz, an understanding of the present state of the industry and its future direction will be gained.

2.3.1 Growth of the Global EV Market

It is evident that there is a notable increase in electromobility adoption worldwide. From 2023 to 2028, the global EV market is projected to grow significantly, rising from a value of $769.4 billion to approximately $1.08 trillion (Statista Research Department, 2024g).

Examining the global landscape of EV markets, three major regions represent the most significant markets: China, Europe, and North America. The following graphic illustrates the number of BEVs sold across regions (incl. the rest of the world) in 2021 and 2022, along with a forecast through to 2035.

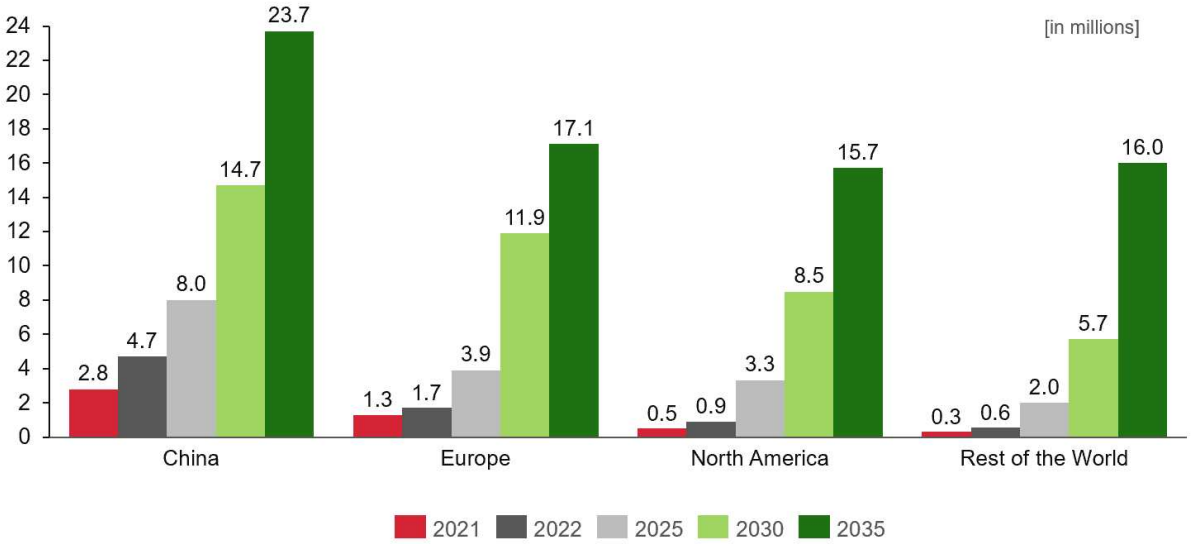

Figure 1: Number of BEVs sold across regions in 2021 and 2022, with forecast through 2035 (Statista Research Department, 2024h).

In 2022, China was by far the largest region for the sales of BEVs, with approximately 4.7 million BEVs sold. In Europe, approximately 1.7 million units were sold, while in North America, sales reached close to one million. By 2035, sales in North America are projected to

rise to approximately 15 million vehicles, while in China, sales are expected to reach approximately 23.7 million vehicles (Statista Research Department, 2024h).

A detailed examination of the European market, as illustrated in the following graphic, shows the distribution of new EV registrations in 2023.

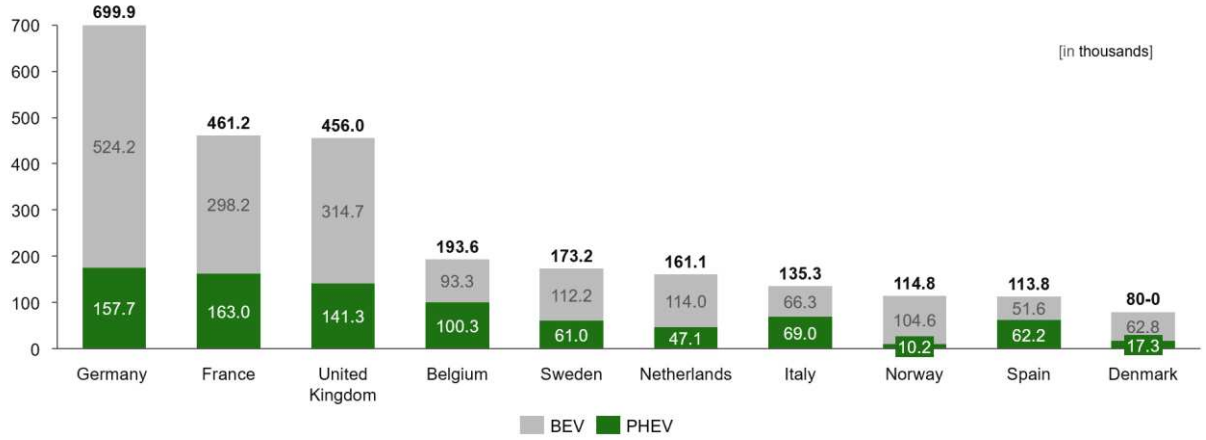

Figure 2: Top 10 countries in Europe with the highest number of new BEV registrations in 2023 (Statista Research Department, 2024d).

Most registrations occurred in Germany, totaling approximately 524,200 BEVs and 175,700 PHEVs, followed by nearly 461,200 vehicles in France and 456,000 in the United Kingdom (Statista Research Department, 2024i).

2.3.2 Drivers & Challenges

The advancement of e-mobility is shaped by a complex interplay of factors, including supportive government policies, technological innovations, and evolving business models. Governments across the globe are implementing subsidies, tax incentives, and more stringent emission targets with the objective of promoting the adoption of EVs, in alignment with global climate goals (Statista Research Department, 2024j). Germany serves as one example of government support for e-mobility. To meet its CO_2 reduction targets by 2030, the German government has introduced significant subsidies, such as the “Umweltbonus” (environmental bonus), which offers up to €6,000 for electric or fuel cell cars and up to €4,500 for hybrid electric vehicles with rechargeable batteries (The Federal Government, 2020). As of 1 December 2023, the German Federal Office for Economic Affairs and Export Control (BAFA) has received a total of 2.23 million applications for the environmental bonus, which includes

approximately 1.43 million EVs, 0.8 million PHEVs, and 500 FCEVs since 2016 (German Federal Office for Economic Affairs and Export Control, 2023).

Furthermore, Tesla played a pivotal role in reshaping the perception of EVs. Often referred to as the "Tesla effect", the company demonstrated that EVs can combine high performance, innovative design, and zero emissions, proving their viability and desirability in the mainstream market (Statista Research Department, 2024j).

Alongside the improved image of EVs fostered by Tesla, the significant reduction in battery prices has further boosted their affordability and adoption. In November 2023, Bloomberg New Energy Finance published a report indicating that the price of lithium-ion battery packs had decreased by 14% from the previous year, reaching a record low of $139 per kilowatt-hour (kWh). This trend is represented by the accompanying diagram, which shows the volume-weighted average price of lithium-ion batteries from 2013 to 2023 (BloombergNEF, 2023).

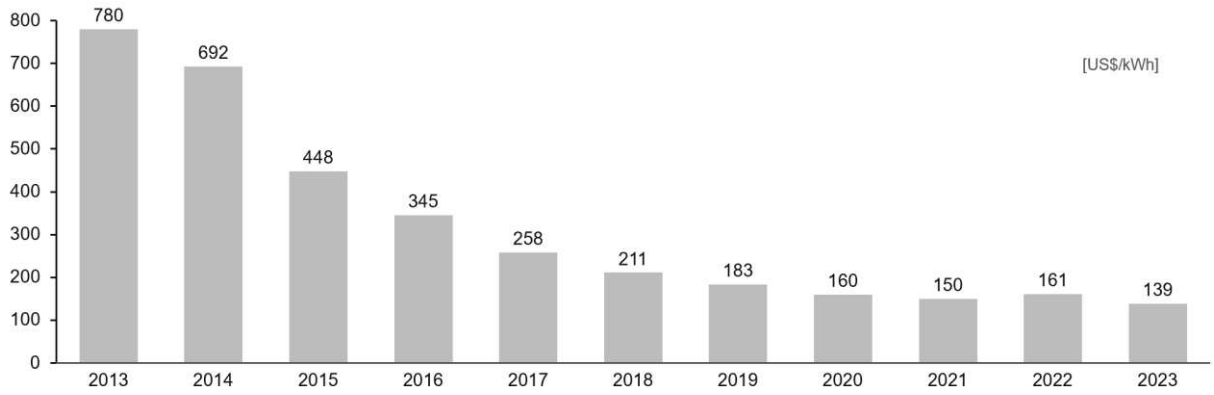

Figure 3: Volume-weighted average price of lithium-ion batteries from 2013 to 2023 (BloombergNEF, 2023).

Over this period, prices dropped significantly from $780 per kWh in 2013 to $139 per kWh in 2023. The decline was primarily attributed to a reduction in raw material and component costs, coupled with an expansion in production capacity across the battery value chain (BloombergNEF, 2023).

In examining consumer demand, Austman and Vigne (2021) highlight that, contrary to popular belief, environmental awareness is not the sole driver of EV sales. Instead, the growth of the EV market is shaped by a range of additional factors, including the availability of supporting infrastructure, government subsidies, and vehicle costs. This is also reflected in the Consumer Monitor Report 2023 of the European Alternative Fuels Observatory of the European Commission (2021). The median price that German consumers are willing to pay for new ICEVs is €20,000, while the median price for new or used BEVs is €25,000. However, while

49% of consumers expressed a preference for a vehicle with a minimum range of 500 kilometers, there is currently only a limited range of models that align with this requirement within their budget (European Alternative Fuels Observatory, 2024). Similarly, the situation in China demonstrates that consumers are willing to pay a premium for EVs in comparison to conventional vehicles. The study of Hong et al. (2024) indicates that Chinese consumers are willing to pay a premium for EVs that offer significant enhancements in key attributes which includes enhancements in battery warranty periods, reduced charging times, and extended driving ranges. These factors exert a considerable influence on consumer purchasing decisions, indicating that while cost is undoubtedly a significant factor, the perceived benefits and reliability of the product are of equal importance in shaping the demand for EVs in China (Hong et al., 2024).

Nevertheless, the transition to e-mobility is confronted with a number of challenges. One significant obstacle is the inadequate and non-uniform charging infrastructure, which gives rise to concerns about range and acts as a deterrent to potential purchasers (Statista Research Department, 2024j). A recent McKinsey survey indicates that consumer concerns about EV charging infrastructure have significant impact on purchasing decisions. 42% of prospective purchasers which are reluctant to transition from ICEVs to EVs indicated that they would only consider an EV if the availability of public charging stations matched that of current gas stations (Fischer et al., 2024).

Additionally, the EV industry faces significant challenges regarding the manufacturing cost of EVs, which is largely attributable to the high cost of batteries, which constitute approximately 50% of a vehicle's price. Despite the decline in battery prices, they remain uncompetitive with traditional vehicles. Prominent examples of this issue include Tesla which became profitable only in 2020 after years of losses. Furthermore, Ford's EV division reported a $1.3 billion loss in Q1 2023 and anticipates losses up to $5.5 billion for the entirety of the year. This has resulted in the postponement of several key EV launches, with the company focusing on achieving profitability (Statista Research Department, 2024j).

2.3.3 Perceived Value Model and Perceived Risk

Consumers play an important role in the transformation of the automotive industry, as their preferences and purchasing behavior drive the take-up of new automotive technologies such as EVs, autonomous driving and alternative mobility solutions. As traditional automakers and new

entrants compete to meet evolving consumer demands, understanding how consumers evaluate products is essential.

The relationship between price, quality, perceived value, and purchase intention was initially conceptualized by Monroe and Krishnan (1985) in their Perceived Value Model (Figure 4).

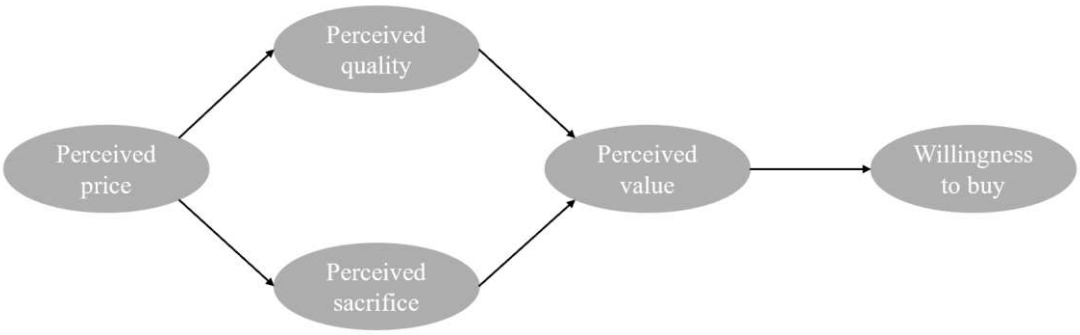

Figure 4: Perceived Value Model (Monroe and Krishnan, 1985)

In this model, price encompasses two interrelated concepts: the objective price and the perceived price, which is shaped by the consumer's interpretation. Perceived quality reflects the benefits consumers expect to receive, while perceived sacrifice refers to the costs they are willing to incur to purchase the product (Zeithaml, 1988).

Consumers often assume that price signals quality, based on the idea that higher prices indicate higher quality due to supply and demand dynamics. Price not only reflects the quality of the product, but also represents the monetary sacrifice required (Lee et al., 2013). According to Monroe and Krishnan's (1985) Perceived Value Model, perceived price influences both perceived quality and perceived sacrifice. When quality outweighs sacrifice, the product is perceived as having positive value, which influences purchase intentions (Lee et al., 2013).

The concept of perceived risk complements perceived value. Bauer (1960) defined perceived risk as the negative perception of uncertain outcomes associated with a purchase. When consumers are uncertain whether a product will meet their expectations, perceived risk may influence their decisions, adding complexity to the Perceived Value Model.

2.3.4 The Electrification Efforts of German OEMs

The three major German automotive OEMs – Volkswagen Group, BMW Group and the Mercedes-Benz Group – are moving towards electrified powertrain concepts. By the year 2030, Volkswagen has set a goal of generating at least 70% of its sales in Europe from BEVs and

50% in the USA and China within the same timeframe. Since the initial delivery of its fully EV, the ID. 3, in September 2020, the company has distributed more than 500,000 vehicles from the ID. family globally. This represents a significant milestone in the implementation of the company's ACCELERATE strategy, which aims to establish the group as a zero-emission, software-driven mobility services provider (Volkswagen Group, n.d.-b). Audi, which is also part of the Volkswagen Group, has announced its intention to launch only EVs from 2026 onwards and aims to offer at least one EV in each of its core product segments by 2027 (Audi, n.d.). Moreover, the Volkswagen Group aims to redefine future mobility by leveraging autonomous driving. In its transition form a traditional vehicle manufacturer to an integrated mobility provider, Volkswagen offers a carpooling platform in Hamburg and Hanover (Germany) by its entity MOIA, with plans to introduce driverless vehicles by the middle of the decade (Volkswagen Group, n.d.-a).

BMW was an early entrant into the EV market, launching its sub-brand BMW i in 2011. In 2013, the company introduced its first fully electric model, the BMW i3, thereby demonstrating its commitment to electric mobility (Krzywdzinski et al., 2023). As of now, customers of BMW, MINI, and Rolls-Royce have the option of selecting from eight all-electric models, which are complemented by a variety of PHEVs from BMW and MINI. By the conclusion of 2022, the BMW Group has delivered more than 1.4 million EVs to customers and has set a goal of achieving a 50% share of BEVs by 2030 (BMW Group, n.d.-a). Furthermore, the BMW Group has introduced a partially automated driving technology, becoming the first automaker in Germany to offer such a system for speeds up to 130 km/h. From spring 2024, the BMW 7 Series is equipped with the BMW Personal Pilot L3, which will facilitate highly automated driving. Level 2 and 3 automated driving have now become integral to BMW's product range, with further innovations anticipated (BMW Group, n.d.-b).

Also, Mercedes Benz is engaged in a restructuring process with the objective of achieving full electrification by 2030, which will result in a lineup of fully EVs. Investments of more than €40 billion will facilitate this transition, with a particular focus on the development of battery technology and the establishment of a comprehensive charging network. Furthermore, Mercedes-Benz is refining its training programs for employees to equip them with the necessary skills to meet the challenges of the forthcoming transition to electric mobility (Mercedes-Benz Group AG, 2021). Furthermore, as part of its technology research initiatives in China, Mercedes-Benz is engaged in Level 4 autonomous driving testing, with the objective of advancing the development of automated driving system software and hardware. Earlier, at the

end of 2023, the company became one of the first automakers to secure approval for Level 3 testing in Beijing (Mercedes-Benz Group AG, 2024b)

3. Methodology

3.1 Research Design

The research design, aimed at identifying factors that enable German OEMs to compete with non-automotive entrants in the global automotive market, is illustrated in Figure 5.

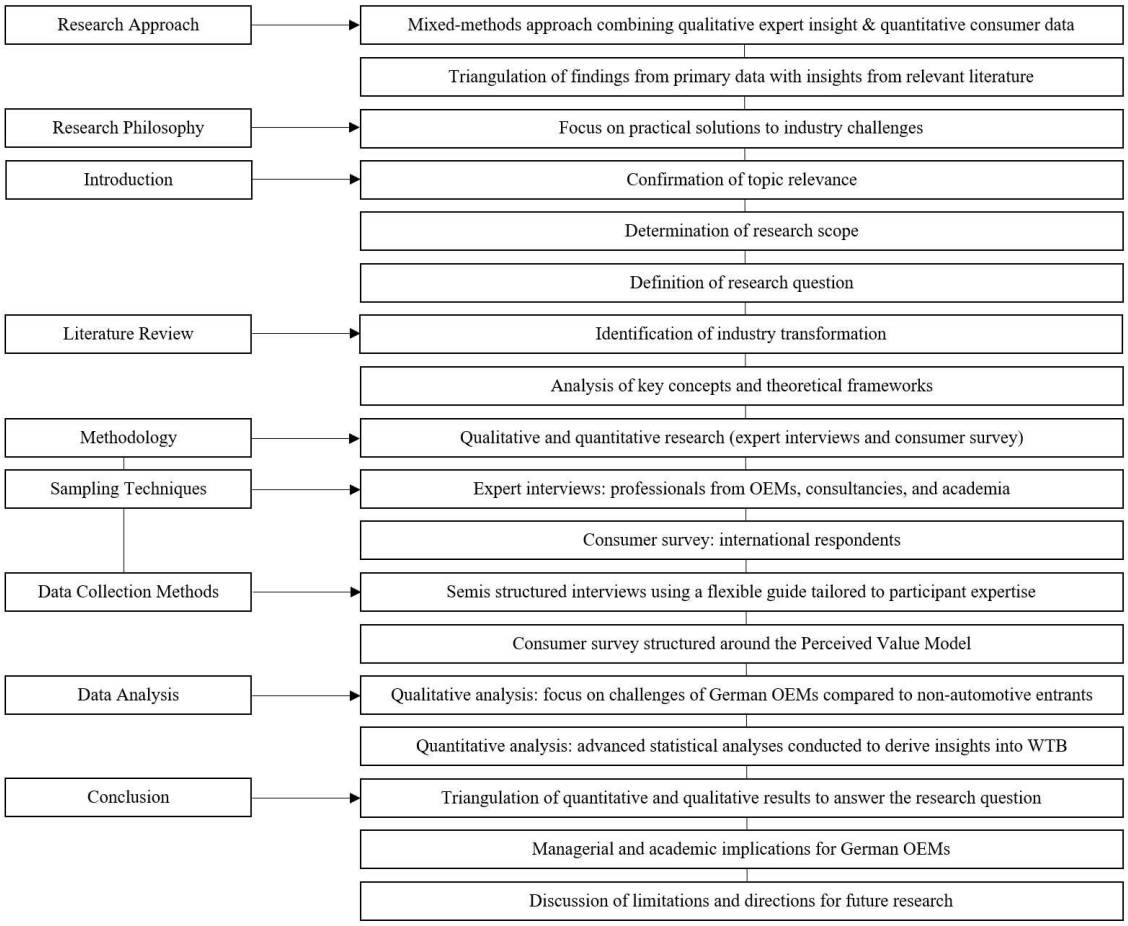

Figure 5: Research design (own illustration)

To understand the impact of non-automotive entrants on the automotive industry, this research used a mixed-methods approach combining qualitative and quantitative data. Expert interviews explored industry perspectives on non-automotive companies entering the market, while a consumer survey examined customer perceptions. A comprehensive literature review complemented these findings for a holistic analysis.

3.2 Primary Data Collection - Qualitative Data

Semi-structured interviews (SSIs) were conducted with eleven experts, allowing for in-depth, open-ended discussions. SSIs allow participants to share their unique perspectives while the interviewer explores key insights and emerging themes (Adams, 2015). An interview guide was developed based on Adams' recommendations, providing a flexible framework tailored to each participant group to ensure relevance and spontaneity.

In order to capture different perspectives, experts from the German and international automotive industry were interviewed. Participants represented a range of professional backgrounds, including OEMs, Tier-1 suppliers, consultancies, academia and industry associations, to provide a comprehensive view of the topic. Interviews were arranged via LinkedIn, personal networks and referrals, and were conducted both in person and virtually using platforms such as Microsoft Teams and Zoom. Summaries of the corresponding interviews can be found in the Appendix.

3.3 Primary Data Collection - Quantitative Data

The literature review showed that the adoption of technologies such as EVs and autonomous driving depends heavily on consumer acceptance, in addition to regulatory factors. While studies have focused on autonomous driving, EVs and shared mobility, little research has examined consumer acceptance of vehicles from non-automotive companies. To address this gap, a consumer survey was conducted to explore how potential customers perceive and accept such vehicles also in comparison to cars from German OEMs.

The conceptual framework for this study's survey has been developed and extended based on the Perceived Value Model by Monroe and Krishnan (1985) introduced in Chapter 2.3.3. While the original model emphasizes the interrelationship between perceived price, perceived quality, perceived sacrifice and perceived value, this study's adapted model (Figure 4) incorporates additional elements relevant to understanding consumer attitudes in the transforming automotive landscape.

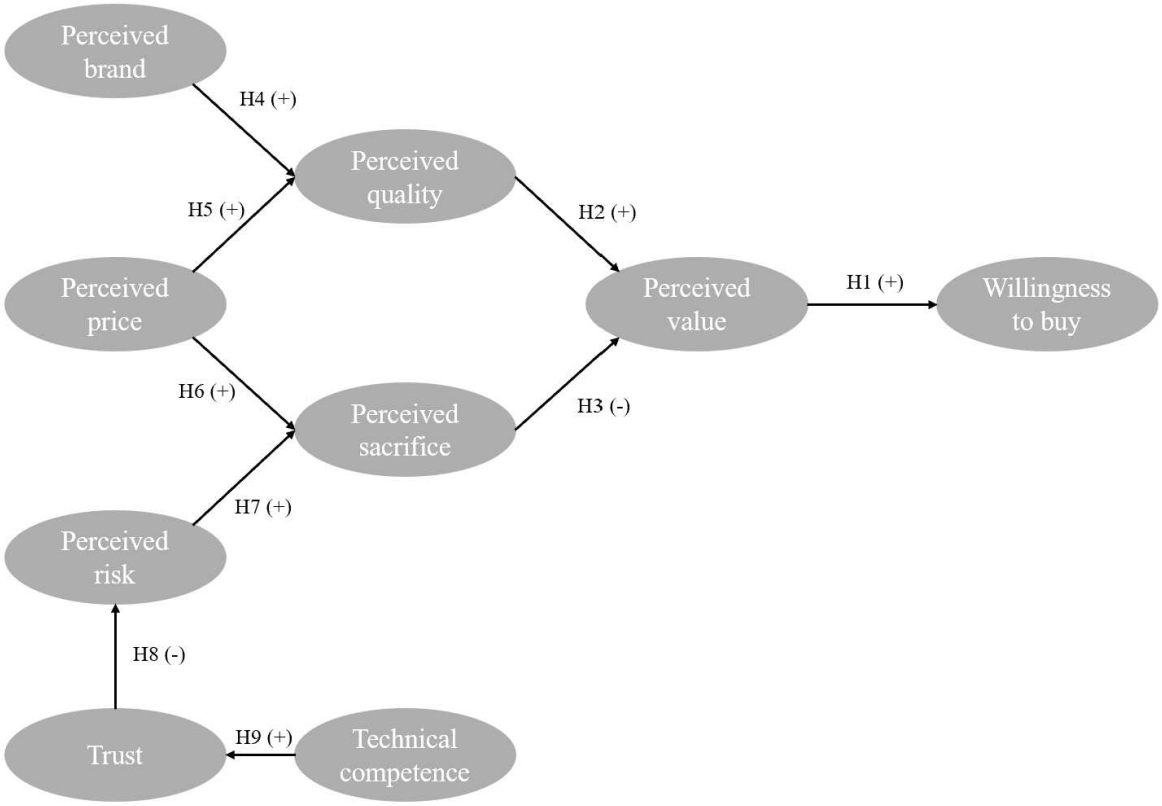

Figure 6: Conceptual model (own illustration)

In the adapted model, brand perception directly influences perceived quality. In addition, perceived risk, discussed in Section 2.3.3, is extended to include trust and technical competence. 'Trust' refers to confidence in the reliability, accuracy, and support of a system to ensure expected performance and control (Choi & Ji, 2015). According to the same study, 'Technical competence' reflects the user's perception of the vehicle's performance.

The survey questionnaire was divided into nine sections: purchase intention, perceived value, price, quality, sacrifice, risk, brand, trust and technical competence. A separate section collected socio-demographic data. Responses were evaluated using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The survey was conducted in English and German via Qualtrics and targeted an international audience. Of 172 participants, 91.9% (n = 158) completed the survey. Incomplete responses were excluded, leaving only fully completed responses for analysis.

4. Analysis and Discussion

In the following section, the results of the expert interviews are analyzed in detail in Chapter 4.1. The results of the survey are then examined in Chapter 4.2. The aim of this section is to answer the research question *What factors are enabling German OEMs to compete with non-automotive entrants in the global automotive market?* This was achieved by synthesizing the data collected through both primary and secondary data collection methods, providing a comprehensive basis for deriving actionable insights and strategic recommendations.

4.1 Qualitative Results of the Expert Interviews

Keyword analysis, following the approach outlined by Gibbs (2007), was used to systematically examine the data collected from the expert interviews. This method was used to identify recurring themes, patterns and terminology that reveal the underlying factors influencing the competitiveness of German OEMs compared to non-automotive entrants. By analyzing the terms and concepts emphasized by the participants, key insights into the strengths, weaknesses and strategic priorities within the evolving automotive landscape were derived.

4.1.1 Identified Strengths of German OEMs

Table 1 illustrates the keywords and phrases extracted from the interviews and classified according to the strengths of the German OEMs as identified by the experts.

Table 1: Strengths of German OEMs

Coded Category	**Trigger Key Words & Phrases**
Brand Reputation and Heritage	Brand image, tradition, representative, national pride, image, established brand, made in Germany, brand reputation, loyalty, brand awareness
Engineering and Operational Excellence	Quality, experience, German strengths, standard operating procedure, German engineers, leading position, engineering
Premium Market Leadership	Premium segment, premium market, premium advantage, premium approach, premium brands

As shown in Figure 7, Brand Reputation and Heritage as well as Engineering and Operational Excellence was highlighted by the highest number of experts, eight in total, closely followed by Premium Market Leadership, mentioned by seven experts.

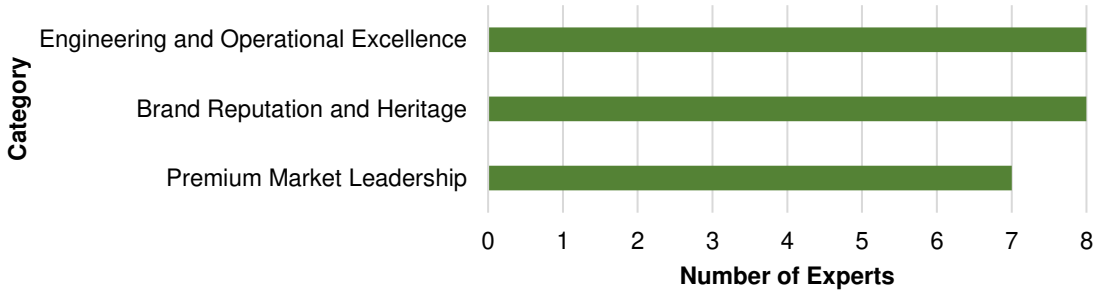

Figure 7: Identified advantages of German OEMs by number of experts (own illustration)

The experts highlighted that German OEMs are widely regarded for their engineering precision and quality, which has been developed over decades of vehicle production. Expert C specifically mentioned combustion engines, powertrains, and body construction as exemplars of German engineering excellence. Adding to this, Expert B further emphasized, "They are strong in their strengths, where they have always been strong." In direct comparison with non-automotive entrants, Expert B remarked, "When it comes to mechanics and hardware, we [German OEMS] are better." The notion of engineering excellence is closely associated with German engineering craftsmanship, a quality that has been acknowledged by numerous experts. Expert E highlighted this by stating, "German engineers still have an absolute worldwide reputation." This is aligned with the analysis presented in Section 2.1.3, wherein the human capital is identified as a principal resource that contributes to the industry's success. In addition to the aforementioned engineering excellence, the operational excellence of German OEMs has also been identified as a key strength. As noted by Expert I, German OEMs have developed a robust standard operating procedure and a highly process-driven business model over recent years, which has contributed to their current level of strength and market position. Expert C further confirmed this by stating, "Operational excellence is absolutely in our DNA, built over years of accumulated experience."

The second area of strength for German OEMs is the strength of brand reputation and heritage. As Expert D stated, "The brand recognition, the trust – these are incredible assets of all established OEMs, especially the incredible assets of the premium OEMs." Additionally, the experts identified brand reputation as a significant competitive advantage for German OEMs in comparison to new market entrants. A considerable proportion of consumers continue to hold reservations about newer brands, particularly those originating from China, such as Xiaomi. This skepticism towards unfamiliar or emerging brands serves to reinforce the competitive advantage of German OEM. This advantage is not limited to domestic markets ("National

markets buy national products." – Expert D). German brands also have a robust international reputation, particularly in China. Expert H, based in Shanghai, China, emphasized this by stating, "In the minds of Chinese consumers, German cars always represent high quality, which means safety and also convey a sense of representation."

The third category identified by the experts as a strength of German OEMs is their strong leadership in the premium segment. A crucial element of premium segment leadership is the emphasis on variance and individualization, which plays a significant role in meeting customer expectations. Expert C emphasized the significance of interior customization options, such as the selection of seat colors or lighting configurations, stating, "With the topic of individualization, you can be extremely present, and that's how you win over a customer, of course." However, it was also highlighted that the premium leadership of German OEMs is not a given and that they must implement long-term measures to maintain this status. As Expert E noted, in order for German OEMs to retain their competitive edge in the future, it is essential that the aspects that define the premium segment, such as superior craftsmanship and advanced customization options, are successfully integrated into the world of e-mobility.

4.1.2 Identified Challenges of German OEMs

In addition to the identified strengths of German OEMs, Table 2 illustrates the keywords and phrases extracted from the interviews and classified according to the challenges of the German OEMs in the ongoing transformation of the automotive industry.

Table 2: Identified challenges of German OEMs

Coded Category	**Trigger Key Words & Phrases**
Slow Innovation Cycles	Development cycles, product development process, speed, delay, too slow, innovation concept
Skills Gap and Workforce Transformation	Skilled labor, attractive, employees, automation, skills, software experts, IT experts, training
High Cost and Inefficiencies	Price, cost factor, margin, cost focus, sales, cost structure, transformation costs
Limited Consumer-Centric Digital Features	User-experience, products demanded by the market, customer, software integration, connectivity, local markets
Conservative Leadership Philosophy	Management, leadership, mindset, safety, DNA
Battery and Supply Chain Dependence	Battery technology, battery value creation, purchasing of batteries, supply chain, transformation costs

As presented in Figure 8, Slow Innovation Cycles was the most frequently mentioned issue, cited by nine experts, followed by Skills Gaps and Workforce Transformation and High Cost and Inefficiencies, each mentioned by eight experts. Other challenges include Limited Consumer-Centric Digital Features, Conservative Leadership Philosophy, and Battery and Supply Chain Dependence, each mentioned by minimum four experts.

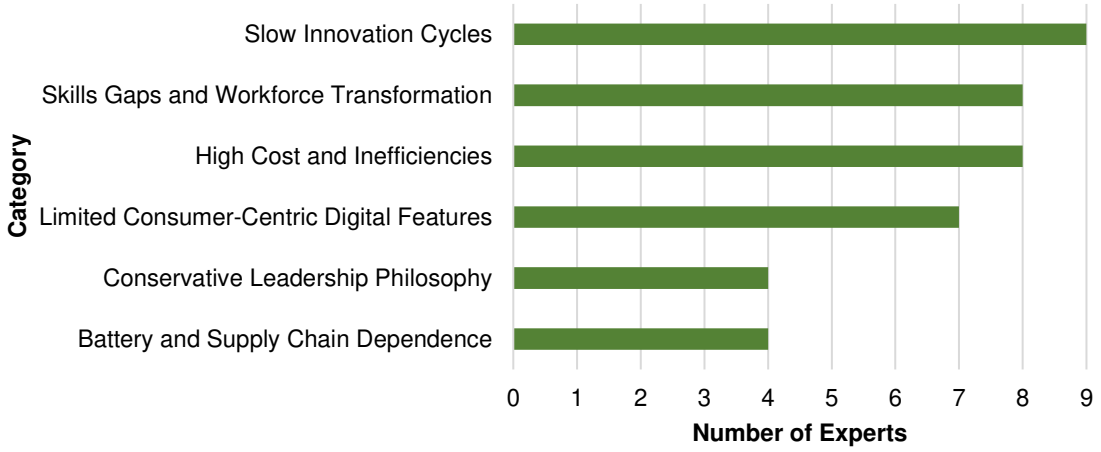

Figure 8: Identified challenges of German OEMs by number of experts (own illustration)

One of the critical challenges German OEMs are facing is their slow innovation cycles, which impedes their capacity to compete effectively in a rapidly evolving global automotive market. It was observed by experts that the conventional development timelines for new vehicle models frequently extend over a period of four to five years, which is considerably longer than the one to two years achieved by numerous competitors, particularly those from China. Expert C attributed this to the slow development cycles of German OEMs, stating, “The [Chinese entrants] don’t achieve this by putting in twice the capacity but rather by employing different development processes. Here in Germany, our engineers always work with the V-model. Every single development step is validated, and that takes time.” This highlighted the contrast between the traditional, validation-heavy approach of German OEMs and the more agile processes adopted by competitors. Additionally, Experts F and K also identified unions as a cause of slow development cycles. Expert F stated, “But the union co-determination that exists in Germany simply slows companies down,” while Expert K confirmed, “We have unions that hold people back.” The experts agreed that these slow development and innovation cycles significantly hinder the competitiveness of German OEMs. Expert F emphasized this point, stating, “If you look today at how long it takes a German OEM to develop a vehicle and then bring it to series production, if you want to understand the vehicle as a technology product, you can’t really allow yourself to do that in the future.”

The slow innovation cycles of German OEMs were frequently attributed by the experts to a conservative leadership philosophy pervasive within these organizations. This leadership approach is typified by a tendency to avoid risk and a pronounced emphasis on safety. Expert D attributed this strong focus on safety to the success of German OEMs over the past 30 to 40 years: “There were always enough markets that wanted to buy these products. And that worked for decades.” Expert C described the organizations of non-automotive entrants as “significantly more dynamic and flexible than a German corporation.” This flexibility allows these new players to adapt more rapidly to market demands and technological advancements, thereby providing them with a competitive advantage in terms of speed and innovation.

According to Expert D, the skills gap and workforce transformation challenge could be attributed directly to the conservative leadership philosophy. As Expert D stated, “The signs of these developments have been there since the 2010s. But they were ignored. This has resulted in organizations failing to build the necessary capacities to prepare for these new developments. We lack software experts, we lack battery specialists.” This was also confirmed by the other experts, though Expert E attributed the issue to the structural assumptions under which workers come to Germany, including the high tax burden with social contributions, which is significantly more expensive than in other European countries. Additionally, Experts B and K ascribed the problem to a growing deficiency in the promotion of internal talent. Expert K asserted that, despite the company’s robust connections with academic institutions in Germany, there is a lack of effective recruitment strategies targeting young, talented individuals. “Instead, they are often directed through temporary employment agencies, where they experience difficulties and eventually transition to an entirely different industry.”

The experts identified two further weaknesses, which are closely interconnected: high costs and inefficiencies, as well as battery and supply chain dependence. Expert A emphasized that the fundamental components of the supply chain are the battery and the entire power train, areas in which German OEMs are significantly underrepresented. Instead of manufacturing these components domestically, German OEMs are reliant on procuring batteries from external suppliers. This reliance not only results in higher battery costs but also contributes to an overall competitive disadvantage by driving up production expenses. Consequently, German OEMs currently face significant challenges in competing effectively in the market for affordable vehicles. Expert D stated that German OEMs and the German suppliers were too slow to react – or in some cases, failed to react at all. Expert A confirmed this perspective, explaining that some suppliers made a deliberate decision not to invest in battery technology. “This, of course,

is now taking its tolls, as it [the battery] has become a significant part of the value chain." (Expert A).

The last challenge identified during the expert interviews was limited consumer-centric digital features. Where German OEMs are failing according to Expert B is the entire topic of software integration, modularization, and the integration of software and hardware into a cohesive ecosystem. "All of this needs to come together to create what I would call a user experience." Expert F pointed out that non-automotive entrant Xiaomi has already achieved exactly this with its latest model, the SU7. "This car is completely integrated into your digital ecosystem. For example, you can control your washing machine at home from your car, or you can step into the car with your Xiaomi tablet and control all the vehicle's functions." Furthermore, Expert I underscored the significance of customization, notably in markets such as China, noting that the necessity for flexibility and a localized approach to clientele has become paramount, superseding the conventional global strategy.

4.1.3 Identified Advantages of Non-Automotive Entrants

Examining the advantages of non-automotive entrants, it can be noted that these companies possess distinctive strengths and innovations that challenge the established practices of German OEMs. A summary of these advantages can be found in Table 3.

Table 3: Identified advantages of non-automotive entrants

Coded Category	**Trigger Key Words & Phrases**
Technological Superiority and Innovation	Core technology, battery, innovation, IoT (Internet of Things), software
Agile Supply Chains	Supply chains, business environment, production
Price Competitiveness	Cheap, alternative, cost effectiveness, cost structure, cost competitiveness
Focus on Customer-Centric User Experience	User-experience, entertainment, digital, customer expectations
Flexibility and Willingness to Take Risks	Dynamic, flexible, brave, fast, new business
Accelerated Development Cycles	Half of the time, development processes, faster

Technological Superiority and Innovation was cited by seven out of eleven experts, making it the most frequently mentioned strength of non-automotive entrants, as illustrated in Figure 9. Agile Supply Chains, Price Competitiveness and Focus on Customer-Centric User Experience

were all equally cited by six experts. Additionally, Flexibility and Willingness to Take Risks and Accelerated Development Cycles were each noted by four experts.

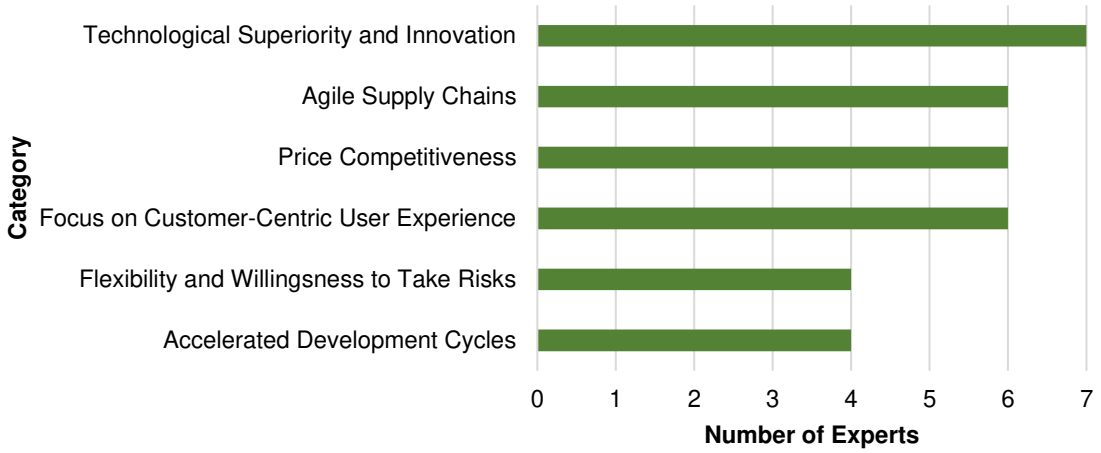

Figure 9: Identified advantages of non-automotive entrants by number of experts (own illustration)

A significant number of interviewees highlighted that companies such as Xiaomi have demonstrated a notable proficiency in the integration of software and the development of interconnected ecosystems. These are areas in which traditional German OEMs are still in the process of developing their capabilities. According to Expert I, these new entrants view vehicles as integrated technology platforms rather than standalone mechanical products. This allows them to deliver seamless user experiences that resonate with modern consumers. The example of Xiaomi's SU7 model by Expert F, discussed in the previous chapter, demonstrated how non-automotive entrants utilize their digital ecosystems to enhance vehicle functionality. Expert H further explained that Xiaomi's technological superiority is rooted in its expertise in the smartphone industry, which shares similarities with car production from a technological standpoint.

Closely connected to the previously discussed advantage of technological superiority and innovation is the advantage of the focus on customer-centric user experience. Expert A emphasized that consumer preferences in the Chinese market exemplify this trend, whereby automobiles are increasingly regarded as more than mere modes of transportation. Such vehicles are frequently utilized as spaces for entertainment, offering a variety of options including movie streaming, karaoke and other leisure activities. This shift in perspective serves to highlight the growing importance of the entertainment factor in vehicles. Additionally, Expert A posited that this trend could potentially impact other markets, such as Germany, where

automobiles may undergo a transformation into multifunctional entertainment hubs. However, Experts E, F, and K expressed skepticism about this trend expanding to European markets.

The role of agile supply chains emerged as another key advantage of non-automotive entrants and was particularly emphasized by the Experts H and I from China. In particular, Expert H pointed out that the Chinese non-automotive entrant Xiaomi benefits from mature supply chains, largely inherited from its established smartphone business, which allows it to optimize costs throughout the production process. Therefore, the advantage of agile supply chains directly contributes to the advantage of price competitiveness, which was also mentioned by the experts. Expert I highlighted Xiaomi's strong supply chain approach, explaining that Xiaomi has consistently prioritized the establishment of its own manufacturing facilities, ensuring cost control and flexibility in testing and integrating design concepts. Furthermore, the company has forged strategic partnerships with leading suppliers such as BYD, while also pursuing the development of its own battery manufacturing capabilities. This dual approach allows Xiaomi to maintain supply chain independence while leveraging partnerships to optimized production efficiency. Expert B confirmed this by also citing Xiaomi as an example for agile supply chains: "Xiaomi strategically collaborates with global Tier-1 suppliers, such as Bosch, Continental, ZF, and Magna, sourcing the necessary component expertise and stripping costs at key points in the value chain to maintain cost efficiency."

The experts identified two further interconnected strengths of non-automotive entrants in the automotive market: flexibility and willingness to take risks, along with accelerated development cycles. Collectively, these strengths drive the competitive advantage of non-automotive entrants. Experts C, D, I and J held the view that that the aforementioned traits facilitate innovation and adaptation to market demands at a pace that traditional OEMs frequently find challenging to match. This was repeatedly associated with the prolonged development cycles of German OEMs, which have already been discussed in detail in Section 4.1.2. However, Experts B, C, and F pointed to Apple as a counterexample, highlighting that not all attempts to enter the automotive market succeed, even when a company demonstrates flexibility and innovation in other industries. Apple's highly publicized plans to develop its own car were eventually abandoned, despite its strong reputation for technological superiority.

4.1.4 Identified Areas for Future Improvement of German OEMs

Considering the shortcomings identified in German OEMs and the strengths observed in non-automotive entrants, recommendations for areas of improvement that German OEMs must address in order to enhance their competitiveness have been summarized in Table 4.

Table 4: Identified areas for future improvement of German OEMs

Coded Category	**Trigger Key Words & Phrases**
Develop Customer-Centric and Innovative Products	Innovative products, customer requirements, local client, product leadership, seamless integration, adaption to change
Focus on Cost-Effective Product Development	Cost structure, optimization, cost factor improvement, competitive, price attractiveness
Enhance Workforce Skills and Attract Talent	Skilled labor, software experts, IT experts, training, skilled workers from abroad, attractiveness
Shift Leadership Philosophy	Shift, philosophy approach, change, mindset, more brave, DNA, more flexible, more dynamic
Forge Strategic Alliances with Tech Companies	Partnerships, tech companies, joint-ventures, collaborations, know-how
Increase Overall Speed and Flexibility	Speed, agility, flexibility, shorten development process

Figure 10 highlights the areas of improvement for German OEMs based on expert insights. Developing Customer-Centric and Innovative Products and Focusing on Cost-Effective Product Development, were each emphasized by eight experts. Enhancing Workforce Skills and Attracting Talent as well as Shifting Leadership Philosophy were identified by six experts. Forging Strategic Alliances with Tech Companies were identified by five experts, while Increasing Overall Speed and Flexibility was noted by four experts.

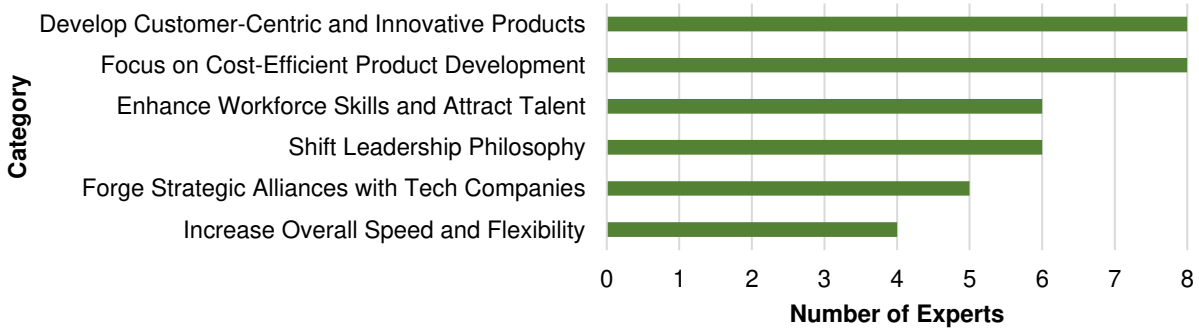

Figure 10: Areas of improvement for German OEMs by number of experts (own illustration)

Experts emphasized the need for German OEMs to develop products that are more customer-focused and cost-effective, in line with the industry's transformation. Experts D and I stressed the importance of adapting to local market requirements, with Expert I stating, "We come from a global market, but right now you really need to think about regional things," and highlighting the Chinese market: "Right now China is already a different market. And I don't think in three or five years it will be the same market as Europe or the US. I think it will develop on its own." Expert C echoed this, noting that "if you want to be successful as a European car manufacturer in China, you also have to solve these customer needs." Expert B emphasized the need for broader innovation: "We have to think beyond the car. We need to think beyond mobility.", advocating the integration of software and hardware into a cohesive ecosystem. Pricing was another focus, with Expert D noting that "the product has to be attractive at a good price" as consumers are less willing to pay a premium. To achieve cost efficiency, Experts B, E, H, I and K identified key measures such as automation, investment in skilled labor and re-evaluation of profit margins. Expert K emphasized the optimization of human resource processes: "You have to put the right framework in place to ensure that processes are lean, that bureaucracy is reduced, and that people can focus on the essentials so that they can simply get more done in less time."

The issue of enhancing workforce skills and attracting talent has already been identified as a significant challenge for German OEMs by the experts. Expert A stressed the need for companies to make the German automotive industry an attractive proposition for skilled workers from abroad, stating, "Constant promotion of Germany as a location for skilled workers is necessary. It's an international race for the best talent, and all other countries are participating in it." Expert J viewed upskilling and reskilling of the existing workforce as a crucial factor. Expert B posited that the challenge is not merely ensuring an adequate number of proficient software and IT professionals, but also raising the overall educational level across the board. This is crucial to facilitate the performance of higher-skilled, value-adding tasks by a more diverse segment of the population. In conclusion, the enhancement of workforce skills and the attraction of talent necessitate a multifaceted approach, comprising the following measures: the enhancement of the appeal of the German automotive industry to international professionals, investment in the upskilling and reskilling of the existing workforce, and the raising of the overall educational level to meet the demands of high-value, technology-driven tasks.

Another point referenced by the experts was strategic alliances with technology companies. This was identified as a pivotal step for German OEMs to overcome the deficit in digital innovation and software integration. As Expert G highlighted, such collaborations enable

German OEMs to adopt sophisticated technologies while maintaining their core competence in vehicle engineering. Expert A additionally underscored the significance of collaboration, particularly through the utilization of open data and open-source initiatives with other automotive manufacturers and technology companies that possess considerable expertise in software development. Expert A considered this to be a factor that will ensure the competitiveness of German OEMs in the future, stating, “This means more collaboration with tech companies, as well as with companies specializing in battery technology. That’s how the future will look, and then I believe Germany will once again be able to develop competitive cars.”

Furthermore, the experts identified two interrelated factors that are crucial for the future competitiveness of German OEMs: a shift in leadership philosophy and an increase in speed and flexibility. The challenges of a conservative leadership philosophy and slow innovation cycles have already been discussed in Section 4.1.2. To address these challenges, it is imperative that German OEMs adopt a more proactive approach to risk-taking. As Expert D asserted, “only with risk comes innovation.” Expert I drew a connection between this point and the previously discussed topic of workforce transformation, underscoring the necessity for leaders at the executive level who can drive and support change effectively. Expert J acknowledged this necessity and emphasized the obligation of those in leadership roles to foster a more flexible and dynamic work environment. Expert G identified faster decision-making within companies as a prerequisite for achieving shorter development cycles.

4.2 Quantitative Results of the Survey

In the following section, the survey results are presented to analyze the factors influencing the customer willingness to buy, providing insights into the key determinants and their impact on consumer behavior.

4.2.1 Demographics and Background

The demographic analysis (Figure 11) shows that 45.6% of participants were aged 25–34, followed by 27.2% aged 45–64, 17.1% under 25, 7.6% aged 35–44, and 2.5% over 65. Participants represented 16 nationalities, with Germans making up 79.7% of the sample, and other nationalities ranging from 0.6% to 4.4%.

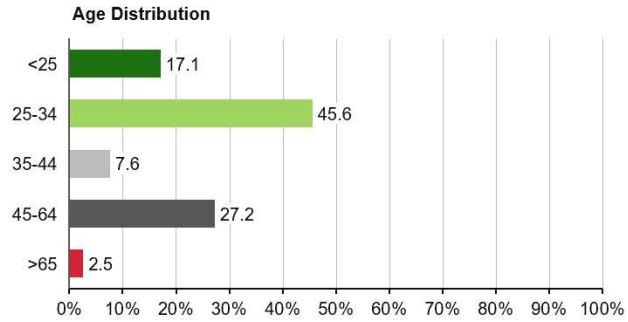

Figure 11: Age distribution of survey participants (own illustration)

Regarding gender, 56.3% of the participants were female (n=89) while the remaining respondents (43.7%) were male (n=69).

Figure 12 illustrates the educational levels of the respondents, demonstrating that the majority have obtained higher qualifications.

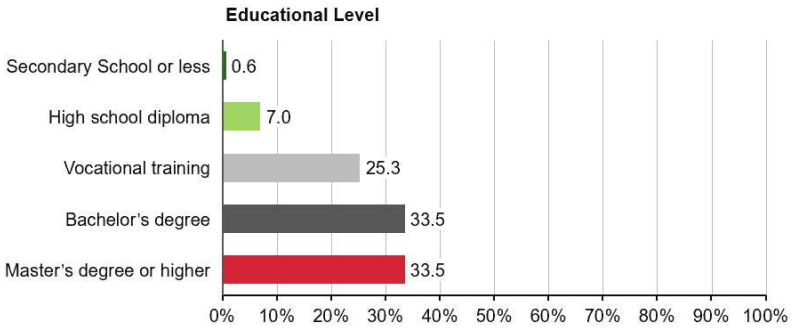

Figure 12: Education distribution of survey participants (own illustration)

In particular, 33.5% of participants had obtained a master's degree or higher, while an equal proportion (33.5%) had obtained a bachelor's degree. The aforementioned two groups collectively accounted for over two-thirds of the sample, which indicated a highly educated respondent base. Furthermore, 25.3% of the participants completed vocational training. Conversely, only 7.0% had obtained a high school diploma as their highest level of education, with a mere 0.6% having completed secondary school or less.

Figure 13 depicts the income distribution among the survey respondents, indicating that the majority of participants earned between €1,000 and €3,000 per month (after tax), with 46.2% of respondents falling within this income bracket.

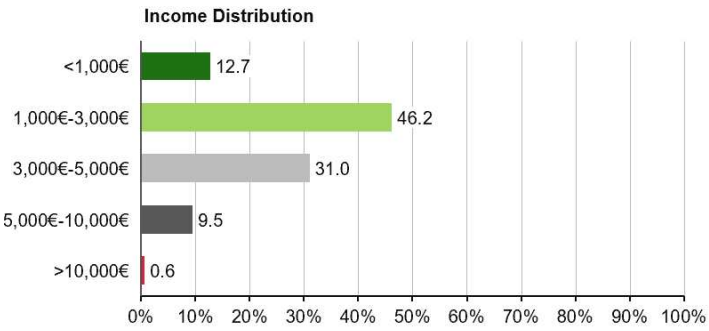

Figure 13: Income distribution of survey participants (own illustration)

This distribution indicates that the majority of respondents were situated within the middle-income brackets, with relatively few individuals falling into the highest or lowest income categories.

As illustrated in Figure 14, the majority resided in urban or metropolitan areas (44.3%), followed by rural or remote locations (37.3%). A smaller proportion of respondents resided in small towns (12.0%), while only 6.3% were located in suburban areas or towns.

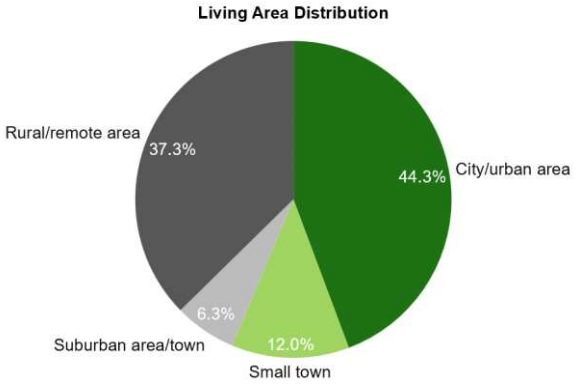

Figure 14: Living area distribution of survey participants (own illustration)

Furthermore, Figure 15 illustrates that the majority of respondents were experienced drivers with 86.1% having more than five years of driving experience and a small minority having limited or no driving experience.

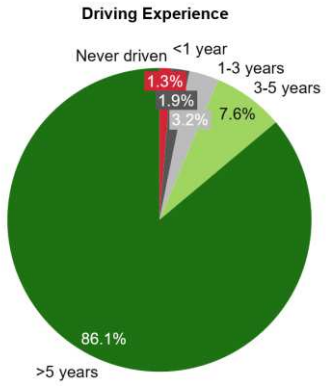

Figure 15: Driving experience distribution of survey participants (own illustration)

4.2.2 Mobility and Consumption Patterns in Transportation

Respondents utilized a range of options, including private vehicles, public transportation, and less conventional alternatives such as bike-sharing programs, scooters, and car-sharing services, as illustrated in Figure 16.

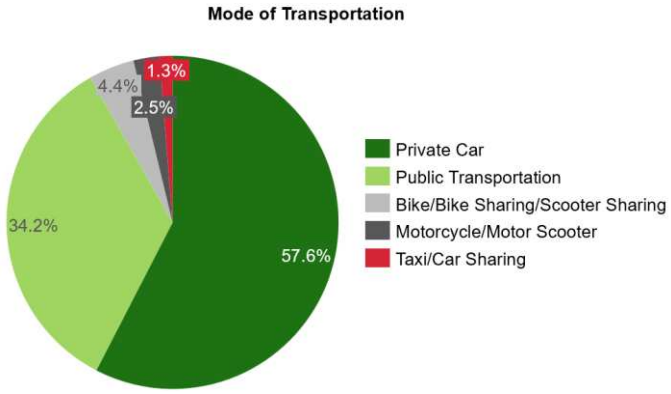

Figure 16: Preferred mode of transportation of survey respondents (own illustration)

The majority of respondents (57.6%) indicated that they rely on private vehicles as their primary mode of transportation. The second most common choice was public transportation, utilized by 34.2% of respondents. In contrast, alternative modes of transportation, such as bike sharing, scooter sharing (4.4%), motorcycles or motor scooters (2.5%), and taxi or car-sharing services (1.3%), were significantly less utilized. These findings served to reinforce the preponderance of traditional mobility options, particularly private vehicles, in respondents' daily lives.

Figure 17 illustrates the respondents' stated intentions to purchase a new car within various timeframes.

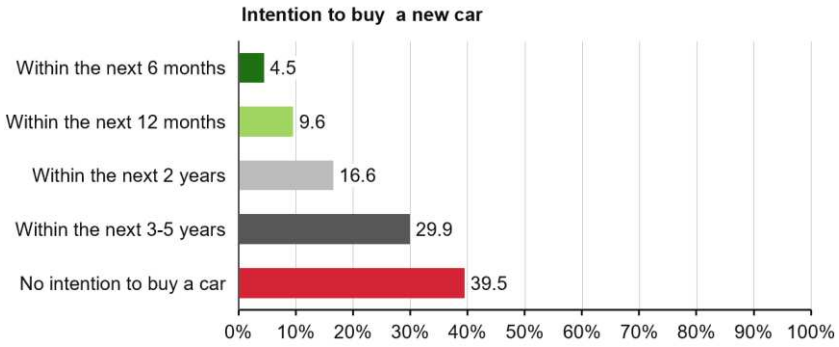

Figure 17: Intention of survey participants to buy a new car (own illustration)

The largest proportion of respondents (39.5%) indicated that they had no intention of purchasing a vehicle in the near future. Meanwhile, 29.9% of respondents indicated that they planned to make a purchase within the next three to five years, making this the most common timeframe for those considering a new car. Smaller proportions intended to purchase within two years (16.6%), 12 months (9.6%), or six months (4.5%). These results indicated that a significant portion of respondents were either not considering purchasing a vehicle or view it as a long-term goal, with fewer individuals planning purchases in the short term.

In addition to the aforementioned findings, Figure 18 demonstrates respondents' intentions to purchase a vehicle from a non-automotive entrant.

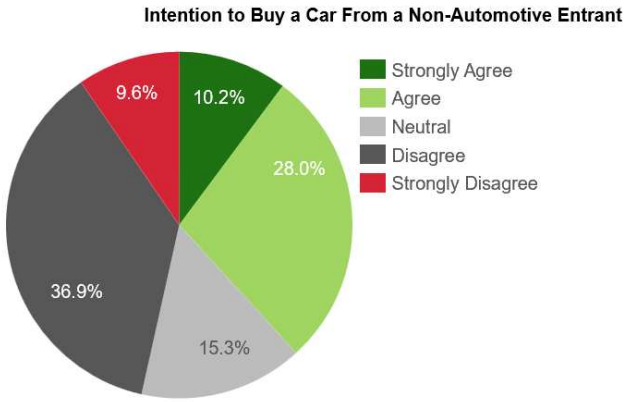

Figure 18: Intention of survey participants to buy a car from a non-automotive entrant (own illustration)

While 36.9% of respondents expressed disagreement with this notion, with 9.6% strongly disapproving, 28.0% expressed agreement, and 10.2% strongly agreeing, indicating a diverse range of perceptions among the participants.

A detailed examination of respondents' prior experience with EVs (Figure 19) and driving assistance systems (Figure 20) revealed significant discrepancies in usage patterns.

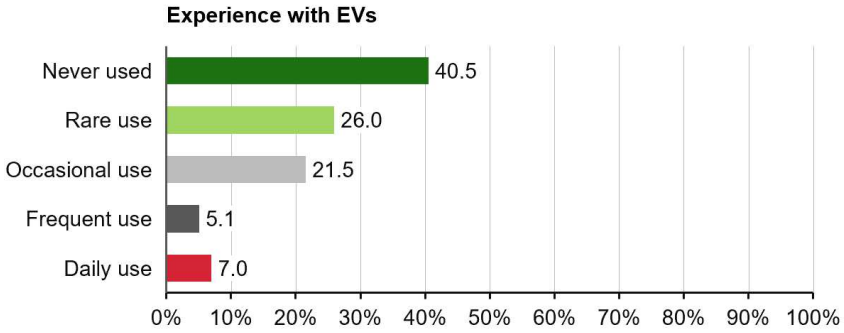

Figure 19: Experience of survey respondents with EVs (own illustration)

With regard to EVs, 40.5% of respondents had never used one, while only 26.0% reported no experience with driving assistance systems.

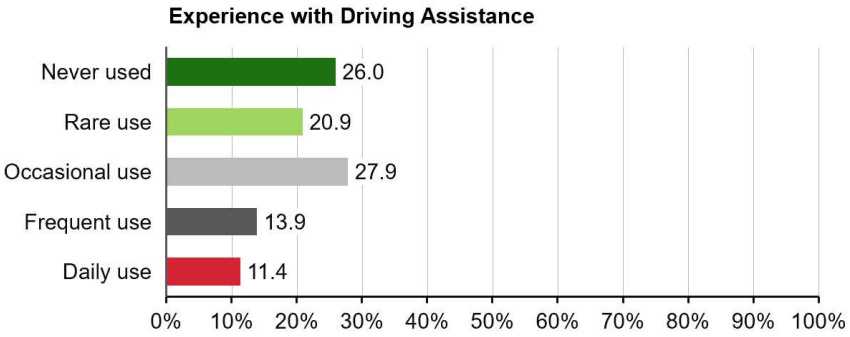

Figure 20: Experience of survey respondents with driving assistance (own illustration)

The data indicated that occasional use of driving assistance systems was more prevalent than that of EVs, with 27.9% of respondents reporting occasional use of driving assistance, compared to 21.5% for EVs. Furthermore, daily or frequent use of driving assistance systems was significantly higher than that of EVs, with 25.3% of respondents utilizing driving assistance systems on a daily or frequent basis, compared to only 12.1% for EVs. These findings suggested that while driving assistance systems are more integrated into regular usage, EVs are still less commonly utilized.

4.2.3 Perceived Value Model and Willingness to Buy

The descriptive statistics illustrated in Table 5 demonstrate that all variables have 158 observations with no missing data, thereby ensuring robustness of the dataset. The mean values are situated around 3 on a 1-to-5 Likert scale, with Perceived Value (3.24), Perceived Sacrifice (3.21), and WTB (3.21) exhibiting the highest scores. The variability is moderate, with standard deviations ranging from 0.79 (Technical Competence) to 1.07 (Perception of Price), indicating a diversity of opinions on pricing. The full response range (1 to 5) is employed, and the data

exhibit symmetrical distributions, as evidenced by the proximity of the mean and median values.

Table 5: Summary statistics for numeric variables

Summary Statistics for Numeric Variables

Variable	count	mean	sd	min	q1	median	q3	max	missing
Perceived.quality	158	3.177215	0.8597066	1	2.5	3.00	4.0	5	0
Perceived.risk	158	2.591772	0.8592668	1	2.0	2.50	3.0	5	0
Perceived.sacrifice	158	3.208861	0.8728298	1	2.5	3.00	4.0	5	0
Perceived.value	158	3.237342	0.8402672	1	3.0	3.00	4.0	5	0
Perception.of.brand	158	2.974683	0.8990396	1	2.5	3.00	3.5	5	0
Perception.of.price	158	3.215190	1.0668232	1	2.0	4.00	4.0	5	0
Technical.competence	158	2.636076	0.7913721	1	2.0	2.50	3.0	5	0
Trust	158	2.939873	0.8358176	1	2.5	3.00	3.5	5	0
WTB	158	3.212025	1.0146919	1	2.5	3.25	4.0	5	0

The correlation matrix (Table 6) is a visual representation of the strength and direction of relationships between the variables. The data demonstrate existence of robust positive correlations, such as those observed between WTB and Perceived Quality (r = 0.71) or Trust and Technical Competence (r = 0.63). These findings lend support to the notion that these relationships are indeed significant. The negative correlation between Perceived Risk and WTB (r = -0.48) indicates an inverse relationship, whereby an increased perception of risk is associated with a reduction in the likelihood of purchase.

Table 6: Correlation matrix

	WTB	Perceived.value	Perceived.sacrifice	Perceived.quality	Perceived.risk	Perception.of.price	Perception.of.brand	Trust	Technical.competence
WTB	1.00	0.50	-0.27	0.71	-0.48	0.41	0.64	0.67	0.51
Perceived.value	0.50	1.00	-0.11	0.53	-0.30	0.28	0.47	0.49	0.43
Perceived.sacrifice	-0.27	-0.11	1.00	-0.33	0.51	-0.17	-0.31	-0.38	-0.26
Perceived.quality	0.71	0.53	-0.33	1.00	-0.48	0.34	0.54	0.67	0.55
Perceived.risk	-0.48	-0.30	0.51	-0.48	1.00	-0.41	-0.34	-0.62	-0.41
Perception.of.price	0.41	0.28	-0.17	0.34	-0.41	1.00	0.20	0.25	0.17
Perception.of.brand	0.64	0.47	-0.31	0.54	-0.34	0.20	1.00	0.55	0.49
Trust	0.67	0.49	-0.38	0.67	-0.62	0.25	0.55	1.00	0.63
Technical.competence	0.51	0.43	-0.26	0.55	-0.41	0.17	0.49	0.63	1.00

The p-value matrix represented in Table 7 served to highlights the statistical significance of correlations between variables, thereby aiding in the decision-making process regarding which hypotheses can be supported. The majority of p-values are $p<0.01$, indicating robust and statistically significant relationships, such as those observed between WTB and Perceived

Quality, or Trust and Technical Competence. These results provide compelling evidence in favor of inclusion of these relationships in the model.

Nevertheless, some correlations, such as that between Perceived Value and Perceived Sacrifice ($p = 0.18$), are not statistically significant, indicating the absence of a meaningful relationship. Consequently, these variables may be excluded from the final model, as their contribution to the hypothesized relationships was likely to be insignificant.

Table 7: P-value matrix

P-Value Matrix (Scientific Notation)

	WTB	Perceived.value	Perceived.sacrifice	Perceived.quality	Perceived.risk	Perception.of.price	Perception.of.brand	Trust	Technical.competence
WTB	NA	2.50e-11	6.67e-04	0.00e+00	1.61e-10	8.36e-08	0.00e+00	0.00e+00	6.76e-12
Perceived.value	2.50e-11	NA	1.80e-01	8.04e-13	1.04e-04	3.03e-04	7.21e-10	1.04e-10	1.14e-08
Perceived.sacrifice	6.67e-04	1.80e-01	NA	1.80e-05	1.31e-11	3.10e-02	8.37e-05	6.20e-07	9.51e-04
Perceived.quality	0.00e+00	8.04e-13	1.80e-05	NA	2.36e-10	1.23e-05	2.04e-13	0.00e+00	5.73e-14
Perceived.risk	1.61e-10	1.04e-04	1.31e-11	2.36e-10	NA	1.09e-07	1.49e-05	0.00e+00	1.10e-07
Perception.of.price	8.36e-08	3.03e-04	3.10e-02	1.23e-05	1.09e-07	NA	1.25e-02	1.51e-03	3.83e-02
Perception.of.brand	0.00e+00	7.21e-10	8.37e-05	2.04e-13	1.49e-05	1.25e-02	NA	4.80e-14	6.04e-11
Trust	0.00e+00	1.04e-10	6.20e-07	0.00e+00	0.00e+00	1.51e-03	4.80e-14	NA	0.00e+00
Technical.competence	6.76e-12	1.14e-08	9.51e-04	5.73e-14	1.10e-07	3.83e-02	6.04e-11	0.00e+00	NA

As a next step, the regression model was employed to empirically test the relationships outlined in the conceptual framework introduced in Section 3.3, which builds upon the Perceived Value Model explained in Section 2.3.3. The influence of key predictors, including Perceived Quality, Perception of Price, Perceived Sacrifice, and Brand Perception, on dependent variables such as Perceived Value, Perceived Quality, and WTB was evaluated using multiple regression analyses conducted in R. The variable Perceived Sacrifice was excluded from the model, as the correlation and p-value analysis demonstrated that there was no statistically significant relationship between this variable and Perceived Value. The weak contribution and lack of statistical significance of this variable justified its removal, thereby improving the clarity and focus of the model on the relevant variables.

The use of parametric methods, such as linear regression, with Likert scale data is supported by evidence demonstrating their robustness to violations of normality and interval-level assumptions. Havlicek and Peterson (1976) show that Pearson correlations, essential for regression, are “insensitive to extreme violations of the basic assumptions of normality and the type of scale” (p. 1332). Norman (2010) argue that aggregated Likert scales approximate interval data, justifying parametric analyses, while Carifio and Perla (2008) highlight that Likert scales with five or more evenly spaced categories behave similarly to interval data. The aggregation of Likert items in this study ensures an approximation of interval data, justifying the use of linear regression.

Table 8: Regression results for H1 - H5

Regression Results for Hypotheses Testing

	Dependent variable:			
	WTB	Perceived Value	Perceived Quality	
	(1)	(2)	(3)	(4)
Perceived Value	0.603***			
	(0.084)			
Perceived Quality		0.518***		
		(0.066)		
Perception of Brand			0.518***	
			(0.064)	
Perception of Price				0.274***
				(0.061)
Constant	1.261***	1.592***	1.637***	2.296***
	(0.280)	(0.218)	(0.200)	(0.205)
Hypothesis	H1	H2	H4	H5
Observations	158	158	158	158
R2	0.249	0.281	0.293	0.116
Adjusted R2	0.244	0.276	0.289	0.110
Residual Std. Error (df = 156)	0.882	0.715	0.725	0.811
F Statistic (df = 1; 156)	51.729***	60.924***	64.719***	20.407***
Note:			*p<0.1; **p<0.05; ***p<0.01	

Upon analysis of the independent variables, it was found that Perceived Value exerts a significant influence on Willingness to Buy (WTB) ($\beta = 0.603$, $p < 0.01$) thereby supporting H1. This indicates that, *ceteris paribus*, an increase in perceived value will lead to an increase in the likelihood of consumers purchasing the product. The significance level ($\alpha = 0.01$) indicates that the result is significant at the 1% threshold. Similarly, for H2, Perceived Quality was identified as a significant predictor of Perceived Value ($\beta = 0.518$, $p < 0.01$). This suggests that, when other factors are held constant, consumers who perceive the product to have a higher quality also perceive greater value. H4 and H5 are also supported by the results. Both Brand Perception ($\beta = 0.518$, $p < 0.01$) and Price Perception ($\beta = 0.274$, $p < 0.01$) were found to be significant in explaining Perceived Quality. These results demonstrate that, *ceteris paribus*, stronger brand perception and higher price perception enhance consumers' quality assessments.

Across all models, the R^2 values indicate that the independent variables collectively explain a moderate proportion of the variance in the dependent variables. However, in social sciences, low R^2 values are common because the phenomena studied are typically influenced by numerous variables, and regression models often explain only part of the variance (Newman & Newman, 2000). Chen and Qi (2023) further emphasize that R^2 should be interpreted with caution, as it may overestimate a model's predictive power.

The results for H6 (Table 9) indicate that there is a statistically significant negative relationship between Perception of Price and Perceived Sacrifice ($\beta = -0.140$, $p < 0.05$). This finding indicates that, under the assumption that all other variables remain constant, a higher perceived price reduces the perceived sacrifice, suggesting that consumers may associate higher prices with greater value or benefits, thereby lowering the sense of personal cost. However, this finding is contrary to the hypothesis that Perception of Price would have a positive effect on Perceived Sacrifice. Consequently, H6 is not supported.

Table 9: Regression results for H6 - H9

Regression Results for Hypotheses Testing

	Dependent variable:			
	Perceived Sacrifice (1)	Perceived Sacrifice (2)	Perceived Risk (3)	Trust (4)
Perceived Price	-0.140**			
	(0.065)			
Perceived Risk		0.513***		
		(0.070)		
Trust			-0.642***	
			(0.064)	
Technical Competence				0.664***
				(0.066)
Constant	3.661***	1.879***	4.478***	1.189***
	(0.219)	(0.192)	(0.197)	(0.181)
Hypothesis	H6	H7	H8	H9
Observations	158	158	158	158
R2	0.029	0.255	0.390	0.395
Adjusted R2	0.023	0.250	0.386	0.391
Residual Std. Error (df = 156)	0.863	0.756	0.673	0.652
F Statistic (df = 1; 156)	4.739**	53.423***	99.562***	101.986***
Note:				*p<0.1; **p<0.05; ***p<0.01

In regard to H7, the results indicate that Perceived Risk has a significant positive effect on Perceived Sacrifice ($\beta = 0.513$, $p < 0.01$). This finding confirms that, when other factors are held constant, higher perceived risk increases the sense of sacrifice consumers associate with a product or service. The analysis, conducted under the hypothesis H8, demonstrates that Trust significantly reduces Perceived Risk ($\beta = -0.642$, $p < 0.01$). Thus, H8 is supported. Lastly, the results demonstrate that Technical Competence has a significant positive effect on Trust ($\beta = 0.664$, $p < 0.01$), indicating that, under the same conditions, higher technical competence fosters greater trust in the product or service.

In addition to testing individual hypotheses, a comprehensive model was conducted with WTB as the sole dependent variable permitting the identification of the most influential variables and their isolated effects, while offering a broader perspective on consumer decision-making. The analysis aimed at identifying the drivers of WTB commenced with the construction of a comprehensive regression model incorporating all independent variables (Table 10).

Table 10: Regression results with WTB as dependent variable

Regression Results: Willingness to Buy as Dependent Variable

	Dependent variable:
	Willingness to Buy
Perceived Value	0.026
	(0.074)
Perceived Sacrifice	0.086
	(0.067)
Perceived Quality	0.373***
	(0.085)
Perceived Risk	-0.042
	(0.083)
Perception of Price	0.166***
	(0.052)
Perception of Brand	0.330***
	(0.071)
Trust	0.297***
	(0.100)
Technical Competence	0.007
	(0.083)
Constant	-0.632
	(0.475)
Observations	158
R2	0.656
Adjusted R2	0.637
Residual Std. Error	0.611 (df = 149)
F Statistic	35.507*** (df = 8; 149)
Note:	*p<0.1; **p<0.05; ***p<0.01

The results demonstrated that four variables—Perceived Quality, Perception of Price, Perception of Brand, and Trust—exhibit a significant positive influence on WTB. Specifically, Perceived Quality emerged as a strong predictor, indicating that higher quality perceptions significantly increase consumers' willingness to buy (β = 0.373, p < 0.01). Similarly, the Perception of Price (β = 0.166, p < 0.01) and the Perception of Brand (β = 0.330, p < 0.01) are found to be positively associated with WTB, indicating that favorable price and brand perceptions enhance purchase intentions. Trust (β = 0.297, p < 0.01) was also identified as a significant driver, underscoring its pivotal role in mitigating uncertainty and fostering consumer confidence. However, the remaining variables – Perceived Value, Perceived Sacrifice, Perceived Risk and Technical Competence – did not demonstrate statistically significant effects (p>0.05). The incorporation of these variables introduced an additional layer of complexity to the model, yet did not enhance its explanatory power. Therefore, these variables were excluded from the model.

The refined model (Table 11), which included only Perceived Quality, Perception of Price, Perception of Brand, and Trust, provided more nuanced insights into the key drivers of WTB.

Table 11: Refined model for regression

Regression Results: Willingness to Buy as Dependent Variable

	Dependent variable:
	Willingness to Buy
Perceived Quality	0.375***
	(0.081)
Perception of Price	0.173***
	(0.048)
Perception of Brand	0.326***
	(0.067)
Trust	0.306***
	(0.082)
Constant	-0.405*
	(0.224)
Observations	158
R2	0.651
Adjusted R2	0.642
Residual Std. Error	0.607 (df = 153)
F Statistic	71.453*** (df = 4; 153)
Note:	*p<0.1; **p<0.05; ***p<0.01

The results demonstrated that Perceived Quality remained the most significant predictor (β = 0.375, $p < 0.01$), confirming its pivotal role in influencing consumer purchase decisions. The Perception of Price (β = 0.173, $p < 0.01$) and the Perception of Brand (β = 0.326, $p < 0.01$) continued to exert a significant positive influence. Furthermore, the construct of Trust (β = 0.306, $p < 0.01$) also demonstrated its continued significance, thereby reinforcing its importance in reducing perceived risks and enhancing willingness to purchase. The refined model achieved an adjusted R^2 of 0.642, slightly improving the explanatory power compared to the initial model.

Subsequently, the Variance Inflation Factor (VIF) was calculated for each independent variable in the final regression model to assess the presence of multicollinearity. The assessment of multicollinearity is a crucial step in ensuring the stability and reliability of regression results .A VIF exceeding 5 is typically regarded as a cause for concern, whereas a VIF above 10 signifies a significant multicollinearity issue that may necessitate adjustment (Menard, 2002). The results showed the following values: Perceived Quality (VIF = 2.08), Perception of Price (VIF = 1.13), Perception of Brand (VIF = 1.56), and Trust (VIF = 2.01). All VIF values were well below the threshold of 5, indicating that multicollinearity is not a concern in this model.

4.3 Succes Factors and Competitiveness of German OEMs

The emergence of non-automotive market entrants has brought to light the specific areas in which these new competitors have demonstrated particular expertise. Their strengths in software-driven innovation, agile development cycles, and customer-centric ecosystems enable them to respond more effectively to rapidly changing consumer demands. These companies view vehicles as integrated technology platforms, combining hardware and software in a seamless manner to create superior user experiences - an area where German OEMs lag behind.

The matrix of success factors (Figure 21) provides a framework to address these challenges by mapping key areas of improvement into actionable categories.

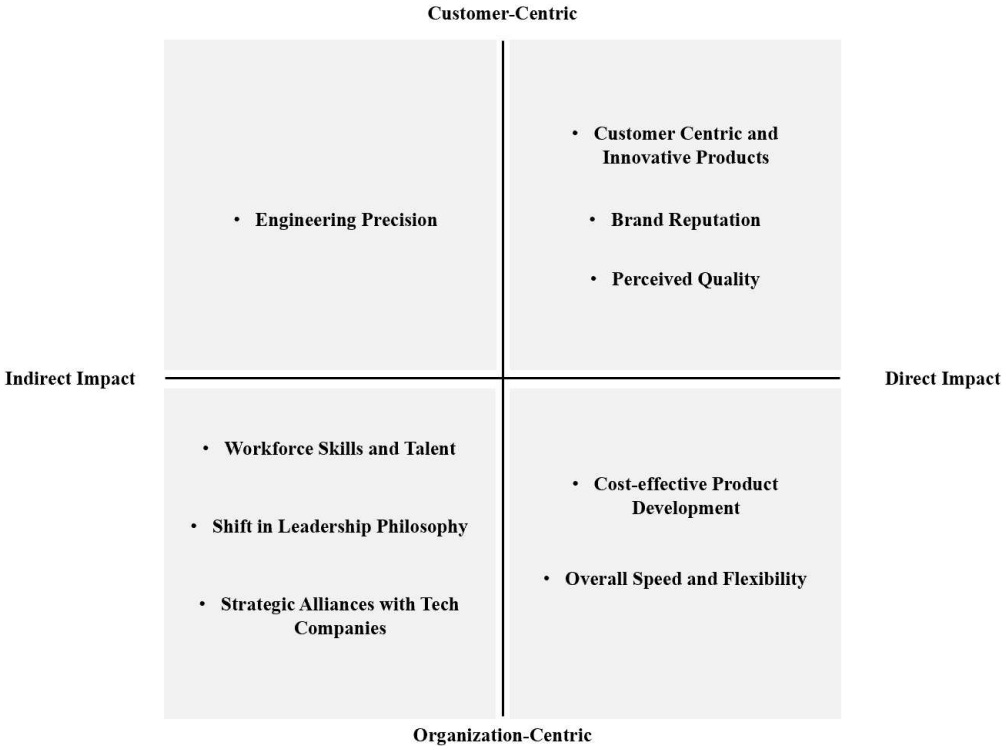

Figure 21: Categorization of success factors of German OEMs (own illustration)

Consumer-Centric Direct factors, such as customer-centric and innovative products, brand reputation, and perceived quality, exert a direct influence on customer decisions and are vital for building loyalty. Consumer-Centric Indirect factors, such as engineering precision, support these direct factors by creating high-quality outputs that reinforce brand perception and consumer satisfaction over time. Organization-Centric Direct factors, such as cost-effective product development and overall speed and flexibility, directly impact operational efficiency and competitiveness, particularly in price-sensitive markets. Finally, Organization-Centric Indirect factors, such as the development of workforce skills, transformation of leadership, and

strategic alliances lay the groundwork for sustained competitiveness and the successful implementation of direct factors.

5. Conclusion

The conclusion triangulates the insights derived from the literature review, expert interviews and quantitative data to address the research question *What factors are enabling German OEMs to compete with non-automotive entrants in the global automotive market?* Furthermore, the discussion addresses the theoretical and practical implications of the findings, as well as the limitations of the study and an outlook for further research.

5.1 Main Findings

German OEMs: Leveraging Strengths

The RBT offers a theoretical framework for grasping the competitive advantage of German OEMs, identifying key resources of the German automotive industry, including physical capital, human capital, and organizational capital. The qualitative findings derived from the expert interviews introduce new elements to this discussion. The experts identified brand reputation and heritage, engineering precision, and operational excellence as central enablers of German OEMs' competitiveness. The results of the survey serve to confirm these qualitative insights. The results demonstrated that perceived quality and brand perception were significant predictors of consumer WTB. These findings reinforce the enduring significance of brand reputation and perceived engineering excellence, even when evaluating competitors.

Challenges in the Context of Market Transformation

Despite their strengths, German OEMs face significant challenges as they transition to meet the demands of electrification, digitalization, and globalization. The expert interviews identified slow innovation cycles, skills gaps, and a conservative leadership philosophy as critical barriers that hinder German OEMs from competing effectively with more agile non-automotive entrants. This leadership philosophy, characterized by risk aversion and a preference for traditional approaches, limits the ability of German OEMs to adopt the dynamic capabilities necessary to navigate rapid changes in technology and market conditions. Furthermore, the high production and operational costs were frequently identified by experts as a significant disadvantage for German OEMs. These costs, which are driven by complex supply chains and a reliance on external suppliers for critical components such as batteries, serve to reduce the competitiveness of German OEMs in price-sensitive market segments. The survey findings

serve to reinforce the necessity of addressing this issue. Perceived price emerged as a significant driver of WTB. Furthermore, the income distribution of survey respondents indicated that the majority are situated within the middle-income brackets, thereby underscoring the necessity for German OEMs to provide cost-competitive products to maintain their relevance to price-conscious consumers. However, non-automotive entrants, with their streamlined cost structures are posing an increasing challenge to German OEMs' ability to compete effectively.

Addressing the Strengths of Non-Automotive Entrants

In order to compete with non-automotive entrants, German OEMs must overcome several key challenges. Bureaucratic structures and slow validation processes hinder their ability to innovate and bring products to market quickly, requiring streamlined workflows and reduced administrative burdens. A considerable skills gap in areas such as software development and digital proficiency further limits their capacity to respond to technological demands, making workforce development essential. Additionally, high production costs compromise their competitiveness in price-sensitive markets, necessitating increased automation and process optimization. Finally, it is imperative for German OEMs to align their offerings with regional consumer preferences and enhance digital integration to ensure their relevance in an industry that is increasingly customer-driven and technology-focused.

5.2 Theoretical Implications

This thesis examined the factors enabling German OEMs to compete with non-automotive entrants, contributing to the academic discourse on competitive advantage in the automotive industry. By integrating expert interviews and quantitative analysis, it explored the interplay between traditional strengths, such as engineering excellence and brand reputation, and emerging challenges like digital transformation and cost efficiency.

The application of frameworks like RBT and Dynamic Capabilities extended existing literature, demonstrating how resources like human capital and R&D enable operational excellence but must be adapted to the agility of non-automotive entrants. Incorporating perceived value models and consumer behavior theories deepened the understanding of factors influencing the willingness to buy from car manufacturers.

By bridging established theories with current challenges, this study advanced knowledge on how German OEMs can leverage their resources while adapting to evolving market dynamics, contributing to strategic adaptation and consumer perception in fast-changing industries.

5.3 Practical Implications

This study presented actionable insights for German OEMs to enhance their competitive position vis-à-vis non-automotive entrants. It identified strategies to accelerate innovation cycles, address skills gaps and optimize cost structures. The study underscored the significance of customer-centric innovation, particularly with regard to the alignment of products with regional preferences, such as personalization in markets like China, and the integration of seamless digital ecosystems. It is recommended that technology partnerships be strengthened and digital capabilities enhanced to meet evolving consumer demands.

By integrating expert insights with quantitative analysis, this research offers German OEMs a framework for leveraging their strengths while adapting to new market dynamics, thereby ensuring their competitiveness in an evolving automotive industry.

5.4 Limitations

This study is subject to several limitations. First, the expert interviews predominantly included participants from German OEMs or suppliers, with no representation from non-automotive entrants. While the expert interviews provided valuable insights, they may reflect a bias toward the perspectives of established industry professionals, potentially underrepresenting viewpoints from more disruptive, non-automotive entrants.

Furthermore, the survey sample, which is predominantly from Germany, limits the generalizability of the findings to global contexts. Although the study captured key factors influencing willingness to buy and competitive dynamics, the exclusion of certain emerging variables, such as rapidly evolving digital trends, may limit its comprehensiveness. In conclusion, the rapid transformation of the automotive industry may result in the obsolescence of some findings as new technologies and market entrants reshape the competitive landscape.

5.5 Further Research

It is recommended that future research incorporates a broader range of perspectives, including insights from non-automotive entrants, in order to provide a more balanced understanding of competitive dynamics in the automotive market. An investigation into the role of emerging technologies, such as SDVs, AI and digital ecosystems, in influencing consumer behavior could provide deeper insights into future market trends. Furthermore, longitudinal studies that monitor the ongoing adaptation strategies of German OEMs over time would be beneficial in

understanding the efficacy of measures aimed at maintaining competitiveness in a rapidly evolving industry.

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Appendices

Appendix A – Overview of Interview Partners

ID	Role of interviewee	Type of company	Relevant experience
A	Division manager Mobility & Logistics	Germany industry and trade association	• Holds a Bachelor's degree in Vehicle Engineering and a Master's in Automotive Systems, specializing in electromobility and autonomous driving. • Function with strong focus on key automotive industry trends like autonomous driving, software-defined vehicles, and vehicle data management
B	Senior Project Manager	Consultancy	• Internship in China with German OEM • Supplier Quality Engineer (Purchasing) at another German OEM • Executive Assistant to the department head • Joined Consultancy as Project Manager focusing on industrial goods and automotive clients
C	Several roles in Sales and Procurement	Tier-1 Supplier	• 12 years of experience with a global automotive supplier • Leadership role managing accounts for Audi, Seat and Lamborghini • Expanded role to manage the entire VW Group, including Porsche • Transitioned to procurement, leading a global cost optimization program and joining the Tier-1's procurement leadership team
D	Consultant	University / Institute for Automobile Economics	• Over 10 years of automotive experience • Includes 3-4 years in OEM strategy development and 8 years in market trend research for Tier-1 supplier • Currently works on a consulting-based strategic project
E	Principal	Consultancy	• Various positions in industry in the field of process optimization and logistics as well as mechanical engineering and maintenance strategies • Almost ten years in consulting, now Principal

			• Works mainly with clients in industry, with a focus on automotive Tier-1 suppliers
F	Senior Specialist Sustainability Statement	German OEM	• Has been working for a German OEM for 8 years • Direct procurement, focusing on components for OEM's electric vehicles • Currently working in corporate communication with a focus on sustainability communication
G	Senior Manager, Strategy & Innovation	German OEM	• Working for eight years for a German OEM in product development and innovation strategy, focusing on adapting development processes for electrification and digitalization
H	Senior Consultant	Consultancy	• Senior Consultant in Shanghai, China focusing on automotive projects especially for branches of German automotive brands • Furthermore, works with Tier-1 suppliers with business in China
I	Senior Project Manager	Consultancy	• Senior Project manager in Shanghai, China • Extensive experience in automotive projects covering the entire supply chain • Worked with OEMs (both international and local), Tier-1 and Tier-2 suppliers • Projects include category strategy, supplier strategy, redesign to cost, and procurement processes
J	Development Engineer / Senior Manager	German OEM	• 15 years of experience in engineering, strategic planning, and supply chain management at a German OEM • Leads the strategic development of electrification
K	Purchasing project lead for new e-motors	German OEM	• Trained as an automotive mechatronics technician, • Worked as a student at German OEM • 3.5 years in purchasing, with 2.5 years directly purchasing components and 1 year managing projects

Appendix B – Summary of Interview A

XS	From your perspectives, what are the most significant trends currently shaping the automotive industry, and do you think that they will last?
A	• Major trends include autonomous driving and software-defined vehicles, with a shift from hardware to software focus • Electromobility is seen not as trend but as future, supported by most automotive manufacturers and suppliers • Believes electric mobility is the most efficient option, but sees a place for hydrogen in sectors like shipping and aviation • Electromobility and autonomous driving as major transformative forces rather than temporary trends; considers them as disruptive changes that redefine the industry's direction
XS	In your opinion, how well is the German automotive industry positioned in the current transformation of the automotive industry?
A	• German OEMs are catching up but still face significant challenges, especially in the supply chain for batteries • Germany currently lacks domestic battery production capabilities and relies heavily on imports, which raises production costs and puts German automakers at a disadvantage in price competitiveness, especially compared to Chinese manufacturers • Value chain of electric vehicles differs greatly from combustion-engine vehicles, with batteries and drivetrains as core components where Germany currently lacks sufficient local production
XS	What barriers do you see for German OEMs in navigating the ongoing transformation of the automotive industry?
A	• Strategic decisions by some suppliers who refrained from entering the battery technology field, due to high investment costs and uncertain returns; this choice now creates a weakness in the supply chain • Lack of clear and consistent political direction in Germany regarding the future of internal combustion engines and the transition to EVs, which has resulted in market uncertainty • Both industry leaders and political policymakers bear responsibility for these challenges, as both sides have not provided clear guidelines for a full shift towards electromobility
XS	Do you see policy as one of the biggest obstacles in this transformation?
A	• Policy plays significant role, particularly with global factors like the Ukraine crisis impacting energy prices and supply chains • Highlights need for Germany to reduce bureaucracy and improve regulatory efficiency to create a more attractive environment for investors, which is essential for supporting the automotive industry's transformation

XS	What is your perspective on the role of non-automotive companies (such as technology firms) in this transformation?
A	• Clear entry of tech firms into the automotive market, with examples like Huawei and Xiaomi building their own cars • Tech companies not only produce vehicles but also embed their software within traditional automotive ecosystems (e.g., Apple CarPlay, Android Auto) • Shift as a sign that tech companies see growth potential in the automotive sector
XS	Do such companies like Xiaomi pose a risk for German OEMs?
A	• While companies like Xiaomi have strong technological capabilities, they still face challenges in scaling their operations to match established OEMs • Building a global network of dealerships, service centers, and logistics is a complex task that takes years to develop, and this is an area where German OEMs currently have an advantage
XS	How should German OEMs adapt their expertise, especially in expertise?
A	• OEMs need to focus on retraining employees, hiring IT talent, and forming partnerships with tech companies to build software capabilities • Germany must also make itself more attractive for international talent and promote the automotive industry as a viable career path for tech graduates
XS	How would you rate the attractiveness of non-automotive company cars in the German market
A	• Chines consumers for example often view cars as an extension of their living space, integrating entertainment options into vehicles due to the high cost and small size of housing in major cities • While this trend is not as prevalent in Germany, it could eventually make its way there, especially as consumers increasingly look for multifunctional vehicles • Tech firms like Xiaomi offer instant connectivity between their devices and vehicles, which is highly valued by customers for the convenience and user experience
XS	What factors will drive competitiveness in the future?
A	• Autonomous driving and advanced driver-assistance systems as critical competitive factors. Additionally, pricing will be crucial, as consumers are likely to gravitate towards more affordable options, even from foreign brands • If Chinese brands can offer significantly lower prices, consumer hesitancy towards non-European brands may diminish over time
XS	How do you envision the competitive landscape in the next 5-10 years?
	• German OEMs will lose some market share, but through international partnerships and strategic investments, they can remain competitive • The German automotive industry will retain a strong position in the premium segments, especially if they make the necessary adaptions to stay relevant
XS	Should Germany focus on the premium segment?
A	• It is a business decision, but a market that is completely dependent on foreign companies would not be an option for a car country like Germany

Appendix C – Summary of Interview B

XS	Do you think trends like e-mobility, autonomous driving, and shared mobility are the future, or will something better come along, like hydrogen for example?
B	• Believes e-mobility is the future, though specific technology might evolve (e.g., solid-state cells) • Expects a global technology mix with combustion engines remaining in rural areas lacking infrastructure • Views hydrogen as suitable for buses, long-haul, or trucks rather than for general automotive use
XS	In your opinion, what would happen if the government banned combustion engines overnight?
B	• Not feasible due to insufficient charging infrastructure. • Significant economic impacts, especially in regions reliant on combustion engines. • A transition would require extensive preparatory frameworks and conditions that are not currently in place
XS	How well are German OEMs positioned in this transformation=
B	• Sees German automakers as “followers” currently. • Strong in traditional strengths (e.g., metalworking) but not in software. • Anticipates increasing demand for software-defined vehicles due to user expectations. • Notes other regions, like China and Israel (Mobileye), are ahead in autonomous driving. • Points to Europe’s slow regulatory processes as a hindrance to competitiveness
XS	Apart from regulations, do you think there are other obstacles?
B	• Regulation limits data collection and usage, slowing product development • Germany’s engineering expertise is strong, but software skills lag • Chinese companies like Xiaomi leverage software-hardware integration expertise and partner with Tier-1 suppliers (e.g., Bosch, ZF) for components • Chinese automakers benefit from government subsidies, creating competitive advantages over Europe
XS	Do you think Germany is an attractive location for the automotive industry now and in the future?
B	• No, Germany isn’t an attractive location for production due to high labor costs and energy expenses. • Innovation potential is still there, but competitiveness in production is low. • Recent industry discussions (e.g., VW, Schaeffler) reflect the challenges of manufacturing in Germany

XS	Given the shift to Software-Defined Vehicles, do you think Germany will need foreign labor to fill skill gaps?
B	• Short-term: Yes, to leverage best practices from Silicon Valley, China, etc. • Mid-term: Emphasizes the need for education reform to focus on high-demand skills. • Germany lacks the educational breadth compared to other countries, so productivity must increase. • Increased automation and high-skilled labor will be essential to remain competitive, if production isn't competitive, there won't be value creation, making wage incentives difficult to sustain
XS	If Xiaomi entered the European market, would it threaten German OEMs?
B	• Yes, particularly if combustion engines are phased out and Xiaomi offers a 30-40% cheaper alternative. • Many consumers can't afford high-priced EVs, so Xiaomi could attract those seeking affordability. • Brand loyalty in Germany might help local OEMs, but the main factor is consumer affordability
XS	Could Xiaomi establish itself in Germany's automotive ecosystem (e.g., workshops)?
B	• EVs require less maintenance, so extensive dealer networks may not be essential. • Strategic partnerships with independent garages could address service needs. • Entry barrier for Xiaomi is likely minimal in terms of after-sales service
XS	Do you think German automakers will focus more on the premium segment in the future?
B	• Possibly, but the premium segment definition will shift. • Traditional markers (size, prestige, power) may become less relevant in EVs. • Premium may focus more on autonomous driving quality and in-car comfort. • German OEMs have potential to position in the premium segment, but need to close gaps in e-mobility, software, infotainment, and user experience
XS	Besides from brand reputation, do German automakers have any current advantages?
B	• Strengths lie in mechanics and hardware. • Potential in automation and productivity if fully pursued. • Weak in software integration, modularization, and creating a unified user experience. • Compared to companies like Apple, German automakers need to think beyond the car itself and integrate across ecosystems
XS	Why do you think Apple may have scaled back in the automotive market?
B	• Multiple factors: high standards, underestimated complexity, and brand reputation concerns.

	• Managing a car fleet, maintaining dealer networks, and upholding quality standards were likely overwhelming. • Struggled to find a unique selling point (USP) comparable to their original iPhone
XS	Finally, what's the key factor that will determine if Germany stays competitive against industry outsiders like Xiaomi?
B	• Top priority: Investment in education to sustain innovation and prosperity. • Need to reduce excessive regulation and streamline policies. • Emphasizes a need for a clear, cohesive national strategy across economic, educational, and environmental policies

Appendix D – Summary of Interview C

XS	From your perspective, what are the most significant trends currently shaping the automotive industry, and do you think that they will last?
C	• E-mobility is clearly the future; we must move away from finite fossil fuels, and EVs are cheaper to produce • Shared mobility will also shape the future as fewer people in urban areas own personal vehicles • Autonomous driving is likely the last to take hold due to region-specific regulations and government allowances
XS	In your opinion, how well is the German automotive industry positioned in the current transformation of the automotive industry?
C	• German OEMs vary in approach, but all recognize the need for transformation • VW is the most committed to e-mobility, influenced by Herbert Diess's dedication to EV technology • VW has clearly separated electric and combustion platforms, whereas BMW offers one platform for both (seen in 3 and 4 Series models) • BMW's setup allows it to adapt to market demands on the same production line, while VW's dedicated e-mobility factories lack this flexibility • VW's rigidity limits adaptability to market fluctuations, affecting cash flow and reinvestment capacity • In shared services, BMW scaled back DriveNow, while VW acquired Europcar and created Moia, establishing a foothold in shared mobility
XS	Regarding employees, as the software component in cars becomes increasingly important, there seems to be a shortage of IT professionals. Do you see it the same way?
C	• Agrees that Germany has an IT specialist shortage, impacting the auto industry.

	• VW previously led the shift to in-house IT with CARIAD, establishing a large IT division focused on digitalization • Now, profitability challenges and competition from higher-paying tech companies (e.g., Apple, Microsoft) make it harder for German OEMs to attract top talent • As a result, German automakers are leaning back toward partnerships with technology companies
XS	Are partnerships with technology companies essential for traditional automakers?
C	• Yes, especially with technology companies, with VW's CEO in China (Brandstätter) pushing for joint ventures to leverage technological synergies • Partnerships will continue to increase, with technology companies and automakers learning from and supporting each other
XS	And if you think about the current challenges for companies like VW or BMW, such as regulations or shortage of skilled workers, what other barriers do you see?
C	• The shortage of skilled labor, especially in tech roles, is a key barrier. • Regulations are less of an issue, as OEMs are supplying a global market • VW's struggle to adapt to Chinese market demands has led to a loss of share in China, which is now focused on local preferences • German automakers have historically assumed that what European customers value would also appeal to Chinese customers, which no longer holds true
XS	Companies like Xiaomi are entering the market. Are they a real threat to German OEMs?
C	• Potential threat if Chinese brands offer cheaper EVs • There's some consumer hesitation about Chinese cars, but safety and design have improved • Chinese OEMs are hiring ex-European designers, tailoring products to European tastes, making them more competitive in Western markets
XS	You mentioned the customization options in the premium market. Looking five to ten years into the future, do you think German OEMs will still dominate? Or will competitors like Chinese automakers gain a foothold?
C	• Believes German OEMs will diversify, with new sub-brands emerging for high-end markets • Expectation that German brands like Porsche, BMW, and Audi will remain strong in the premium segment • In the volume segment, other brands (possibly regional) will gain ground • VW, for example, may remain a volume brand in Europe but is unlikely to stay a standalone brand in China, given market shifts
XS	Comparing operational strengths, where do German OEMs stand compared to companies like Xiaomi?
C	• Operational excellence is embedded in Germany's DNA from years of industry experience

	• European manufacturers sometimes over-engineer, potentially overlooking cost efficiency • German expertise in machinery and automation remains a strength, allowing extensive customization options, which appeals to premium customers. In contrast, Tesla offers minimal customization • Chinese OEMs reportedly have shorter development cycles by using different processes than Germany's V-model, which involves rigorous validations • Feels German OEMs might be over-regulated, complicating their development processes and extending timelines
XS	With the influence of non-automotive companies entering the market, what would you say are the key factors for German OEMs to remain successful?
C	• Partnerships with technology companies are crucial for German OEMs to stay competitive • Collaborating with tech companies allows OEMs to leverage new technologies and scaling efficiencies, adapting to future industry demands

Appendix E – Summary of Interview D

XS	From your perspective, what are the most significant trends currently shaping the automotive industry, and do you think that they will last?

D	• E-mobility is not just a trend but a lasting development driven by significant global investments and regulations
	• Fully battery-electric vehicles (BEVs) are growing, but a mix of powertrains, including hybrids and hydrogen, will remain until at least the 2040s
	• Regional dynamics vary:
	  ○ China leads the BEV shift with rapid adoption (50% NEV market share in 2024)
	  ○ Europe shows slower, politically influenced growth
	  ○ The US lags, with uncertain progress due to regulatory changes under Trump
	• Autonomous driving will progress in specific areas incl. passenger vehicles, commercial vehicles and people movers
	• Shared mobility is declining overall, but specific concepts (e.g., autonomous people movers) could emerge as significant post-2030

XS	How do you view the competitive landscape in the future?
D	• German premium brands may struggle in China due to aggressive local competition (e.g., Xiaomi) offering technologically advanced and more affordable options

	• Outside of China (Europe, US, rest of the world), German OEMs maintain strength in premium markets due to their strong brand image and established reputation • Challenges include faster development cycles and lower costs in China: o Chinese manufacturers develop cars in 2 years at lower costs compared to 5-year cycles in Germany
XS	Do you think Asian brands like Xiaomi could dominate the European market, or will German brands maintain their strong reputation and trust among consumers?

D	• Asian cars will face challenges in Europe due to:
	  o Higher costs to meet European standards
	  o Potential trade tariffs and national preferences favoring local brands
	• Chinese brands may struggle to gain significant market share before 2030 but could establish themselves at levels comparable to Toyota or Hyundai after that

XS	Are there factors within German OEMs that could secure their competitiveness in the future?
D	• German brands benefit from strong global reputations and customer loyalty • High-quality products and robust marketing continue to differentiate German OEMs in premium markets • Challenges include slower innovation and the need to match competitive offerings like Tesla's Model 3
XS	Why do you think no one has matched Tesla's success?
D	• German OEMs underestimated e-mobility's potential and Tesla's innovation • The industry is entrenched in traditional, slow-moving processes and resistant to fundamental change • Limited willingness to innovate and take risks has delayed competitiveness
XS	Is the shortage of skilled workers in Germany a significant challenge?
D	• The shortage of specialists in areas like software and battery technology is critical. • Longstanding reliance on combustion engines and outdated processes have left gaps in organizational capabilities. • German OEMs were slow to prepare for the shift toward e-mobility and related technologies.
XS	How do you see the potential impact of the 2035 combustion engine ban?
D	• Europe will transition entirely to BEVs, but other regions will adopt a mix of powertrains • German OEMs will adapt their production strategies to regional demands, ensuring competitiveness
XS	Do you think the combustion engine ban presents an opportunity for Chinese brands to enter the European market with affordable cars?
D	• Market openness, trade policies, and consumer preferences will heavily influence Chinese brands' success.

	• While Chinese products are competitive, Europe's fragmented national markets and local loyalty may slow their adoption
XS	Summarizing your view, do you believe German OEMs will remain competitive across all segments, not just in the premium market, even if the combustion engine ban is implemented?
D	• German OEMs are well-positioned in premium segments globally, with flexible platforms and strong brand equity. • Non-premium brands like VW face more challenges due to weaker product offerings and higher prices. • Success depends on maintaining innovation and addressing structural inefficiencies
XS	If you had to pick three factors that will determine whether German OEMs succeed in meeting these challenges, what would they be?
D	• Adapting products to evolving market demands, including BEVs and connected autonomous vehicles. • Delivering competitive, high-quality products at attractive price points. • Shifting to a more risk-oriented leadership philosophy that embraces innovation and challenges existing business models

Appendix F – Summary of Interview E

XS	From your perspective, what are the most significant trends currently shaping the automotive industry, and do you think that they will last?
E	• E-mobility and autonomous driving are enduring mega trends • Hydrogen unlikely to succeed due to supply and production constraints • E-fuels also unrealistic for automotive, more likely niche usage in aviation • E-mobility will impact supplier landscape due to lower vehicle complexity and parts • Many traditional suppliers will face challenges as combustion engines phase out
XS	Could you elaborate on the specific challenges suppliers will face?
E	• Reduction in parts intensifies competition, shifts focus on cost • Companies must improve cost structures and competitiveness • Innovations and premium market are the only viable spaces left for German OEMs • Chinese companies will likely dominate the mass e-mobility market • German OEMs, like Volkswagen, are seen as unable to compete effectively in the mass e-mobility market, leaving only the premium segment open for competition
XS	What work do German OEMs need to do long-term?

E	• Focus on competitiveness in electric market while maintaining premium standards • R&D into battery types, range, and premium features is crucial • Successfully transition premium offerings and brand values to the e-mobility sector
XS	Are there other obstacles for OEMs, like skill gaps or regulatory issues?
E	• Significant investments are required to support the transition to e-mobility but political commitment is lacking • High labor costs and current social structure require investment to maintain competitiveness • Collaboration between politics and industry to establish favorable conditions for investments
XS	What is the future role of tech companies in the automotive sector?
E	• Partnerships with tech companies will be crucial as vehicle differentiation decreases • Reduced complexity benefits OEMs from a cost perspective, allowing more standard modules to be sourced • Balancing technological advancement with cost leadership will be key • Innovation will be more important than cost in the premium segment, especially in Germany
XS	How do you view the role of current employees, and do we need to attract international talent?
E	• German engineers have a strong global reputation and the skills to lead this transition • Need investment-friendly environments, support for startups, and research opportunities • Foreign labor will also be necessary to support the transition
XS	Is the German automotive industry attractive enough for this, or is there room for improvement?
E	• German tax and social burdens are high, making it less attractive • Germany has strengths like excellent healthcare, which are often overlooked
XS	Do you see companies like Huawei or Xiaomi as serious competitors for German OEMs?
E	• Huawei and Xiaomi are strong competitors in the mass market, supported by partnerships • Unlikely to compete in the premium segment due to lack of experience in this market • Partnerships where German OEMs source modules from these tech companies are expected
XS	User experience in China is evolving (e.g., car as second living rooms). Do you think this trend will come to Europe?

E	• Personally doubtful, though no hard data; feels this trend may not transfer to Europe
XS	If Xiaomi entered the European market, could they establish themselves quickly, considering the existing infrastructure?
E	• Tesla showed it's possible to build coverage quickly, although there were initial challenges – same with Polestar • Joint ventures or partnerships with local companies could facilitate entry • EU policy considerations will play a role in allowing new entrants
XS	Do you consider brand reputation and safety concerns potential barriers for consumers?
E	• Brand reputation is not a major factor • Safety concerns can be addressed with crash tests and positive media • Consumer attitudes can shift with branding and marketing, as seen with brands like Nokia and Apple
XS	Looking ahead, will the market be dominated by Chinese brands in the mass market and Germany focusing on premium?
E	• The premium segment is open, but Asia will dominate the mass market
XS	If you had to pick three main factors determining Germany's future competitiveness what would they be?
E	• Startup landscape and startup investments • A reformed social system, meaning lower taxes, more net income – need to scale back the welfare state to free up funds for reinvestment to support economic backbone • Strong investments in R&D across all industries to strengthen German automotive and move it into the future

Appendix G – Summary of Interview F

XS	From your perspective, what are the most significant trends currently shaping the automotive industry, and do you think that they will last?
F	• E-mobility will dominate due to unmatched efficiency and cost advantages • Hydrogen and e-fuels will remain niche products due to inefficiencies • Autonomous driving as a slower-developing trend with many technical challenges still to overcome • Shared mobility is declining in importance, BMW for examples has largely exited this area
XS	How would you say the German OEMs are positioned in this transformation? Are politics a hindrance, or is it more about lacking infrastructure for e-mobility?
F	• Blaming politics is too simplistic; companies are also responsible for their slow pace • Need for clearer communication and support for e-mobility infrastructure

	• Current lobbying against the combustion engine ban is considered as short-sighted • Politics share some responsibility but is not solely to blame
XS	Are there other factors or areas where you think Germany, or especially the German OEMs, have a lot of catching up to do?
F	• Skilled labor shortage is a significant challenge, especially in e-mobility and autonomous vehicle software • Labor union co-determination slows down decision-making, creating additional tension for companies • Notes the challenges of operating in different regulatory environments (China, Europe, USA), with faster decision-making in China than in the EU
XS	The transformation is also moving towards software-defined vehicles. Would you say that China is already much further ahead than Germany, especially in terms of user experience within the vehicle?
F	• Software-defined vehicles are important • Chinese cars, like Xiaomi's, are well integrated into digital ecosystems and offer features like in-car TikTok viewing • These features appeal more to Chinese customers but this approach might influence German manufacturers
XS	Looking into the future, say in five to ten years, how do you see the competitive landscape? Do
F	• Doesn't believe Chinese brands will reach the same level as German brands like VW in Europe • Cultural preferences and product differences will limit the appeal of Chinese cars in Europe • Potential threats if the U.S. market closes, which could push Chinese brands to enter Europe more aggressively
XS	So, would you not consider companies from outside the industry, like Xiaomi, serious competition for German OEMs, even if their CEO decided to enter the European market tomorrow?
F	• Currently does not see Xiaomi as serious competition in Europe • Thinks there are significant reservations about Chinese cars, and the price differences are not large enough to drive a switch
XS	What factors do you see, aside from price, that still speak for German cars compared to brands like Xiaomi?
F	• Origin from China plays a role in consumer hesitation • Chinese products are often designed for Chinese consumers, which may not appeal to European buyers • Strong "Made in Germany" pride in Germany but this could also change
XS	Moving away from China for a moment, let's imagine Apple continued developing its car. How do you see that?
F	• Building a car is complex, likely why Apple abandoned the project

	• Apple car would have been premium-priced and differentiated mainly by software • Thinks Apple might have succeeded if it had a technological edge, such as in autonomous driving, but the project's cancellation suggests challenges
XS	Some people think companies like Huawei, Xiaomi, and Sony are producing cars not to actually sell vehicles but to get their technologies and systems into cars long-term. Do you see this as more of a marketing move and that these companies might disappear in five to ten years, or do you think tech companies will eventually sell cars under their brand, even if they don't produce them themselves?
F	• Uncertain about the motivations of companies like Huawei and Xiaomi for entering the car market • Data collection could be a factor, as car data provides insights into customer behavior • Car manufacturing is a tough business, with high competition and low profitability in China
XS	What changes would you implement in the German OEMs?
F	• Heavy investment in AI is crucial to shorten development cycles • Faster development is necessary if vehicles are to be seen as technology products • Co-determination by unions and work councils could resist AI adoption due to potential impact on jobs, but AI adoption is essential • Values sustainability but sees business viability as the primary concern

Appendix H – Summary of Interview G

XS	How do you view the competitive environment for German OEMs, especially with the rise of non-automotive companies like Tesla, Xiaomi, or Huawei?
G	• The competition has intensified due to new entrants like Tesla, known for software and battery innovation • Xiaomi and Huawei bring expertise from consumer electronics, enabling them to innovate quickly and shorten development cycles • German OEMs face pressure to maintain quality while accelerating processes
XS	What do you see as the key strengths keeping the OEM your are working for and other German OEMs competitive?
G	• Brand reputation: German premium OEMs represent engineering excellence and luxury • Expertise in vehicle integration, particularly blending hardware and software • Leadership in the premium market segment, appealing to customers prioritizing quality and innovation • Sustainability initiatives, such as CO2-neutral production targets

XS	Where do you see room for improvement at German OEMs in general?
G	• Accelerating development timelines to keep pace with market trends • Strengthening software capabilities to match tech-focused competitors • Adjusting cost structures to remain competitive, especially against cost-efficient Chinese manufacturers
XS	How do you think partnerships can help German OEMs compete with non-automotive entrants?
G	• Partnerships with tech companies are essential for software and digital innovation • Collaborations in battery technology can address supply chain challenges and reduce costs
XS	What strategic steps do you consider most important for German OEMs to remain competitive in the long term??
G	• Emphasizing faster decision-making and risk-taking in leadership • Continuously investing in sustainability as a core element of brand differentiation • Focusing on regional customization to meet diverse market demands, particularly in China • Leveraging digital ecosystems and integrating customer-centric features
XS	In your view, what role does sustainability play in maintaining competitiveness
G	• Sustainability is both a regulatory necessity and a customer expectation • Initiatives like CO2-neutral production and electrified vehicle lines enhance brand perception and attract eco-conscious consumers
XS	Is there anything else you'd like to emphasize?
G	• Optimistic about the future of German OEMs, particularly Premium OEMs, citing their ability to maintain premium quality • Success will depend on embracing flexibility and adaptability in response to rapid industry shifts

Appendix I – Summary of Interview H

XS	How would you say is the development of electric vehicles in China?

H	• EV business in China has grown significantly in recent years, driven by:
	  ○ Political support encouraging EV adoption for environmental reasons
	  ○ Chinese EV manufacturers mastering core technologies (e.g., batteries and smart driving systems), improving both performance and cost-effectiveness
	• Consumers are increasingly willing to buy EVs due to cost savings and better performance

XS	Would you say one of the most important topics for these new cars is user experience, or what would you say is important for Chinese consumers when considering a car purchase?

H	• Key factors for Chinese consumers:
	  o Cost
	  o Performance and user experience
	  o Brand reputation, which reflects wealth and family status

XS	Is the in-car experience really important for Chinese consumers?
H	• Disagrees, as most people in China commute using public transportation due to traffic congestion. • Notes that manufacturers market the car-as-a-living-room concept by including features like large screens, internet connectivity, and even karaoke, but these aren't major buying factors for consumers
XS	Besides traditional car manufacturers, new companies like Xiaomi or Huawei, which usually produce phones and electronics, are now entering the automotive market. Why do you think they're doing this?

H	• Xiaomi:
	  o Leverages expertise in semiconductors and a mature supply chain in China
	  o Has a strong fan base that would likely adopt Xiaomi cars
	  o Aims to streamline costs by shaping upstream supply chains effectively
	• Huawei:
	  o Acts as a Tier-1 supplier, providing software systems to OEMs
	  o Focuses on core technologies and risk-sharing through collaborations with multiple brands

XS	Do you think German cars will still be a thing in the future in China, or will they lose relevance as Chinese brands grow stronger?
H	• German cars will remain relevant for the next 5–10 years, as they symbolize high quality, safety, and status for Chinese consumers • Chinese brands are growing fast but face financial challenges and require substantial investment • Believes German cars will not lose the market entirely
XS	If German cars stay, will it mostly be in the premium segment due to their reputation and symbolic value? And do you think companies like Xiaomi will come to Europe and compete with German OEMs?
H	• German cars will likely focus on the premium segment, where they already hold a strong reputation • Chinese brands like NIO and Xiaopeng are expanding to East Asia, Eastern Europe, and eventually Western Europe and America • Political factors, such as tariffs, could pose challenges for Chinese brands entering these markets

XS	What factors are essential for German OEMs to stay competitive in China in the future?
H	• User experience is critical: Highlights small screen sizes in German cars as a drawback compared to competitors. • Cost competitiveness is vital German cars have high margins, which is less sustainable in China's highly competitive market. • Pricing battles among manufacturers make cost a decisive factor for Chinese consumers

Appendix J – Summary of Interview I

XS	How would you say is the development of electric vehicles in China?
I	• EVs are already a clear trend, with a penetration level of 40% in the first half of 2024 • Chinese customers are upgrading to higher-quality EVs (mid- to high-price range: 200k–400k RMB) • Safety is a top priority for buyers, followed by features like autopilot, especially for younger customers buying second cars • The market shows a clear direction toward EV adoption
XS	You mentioned that there are many offerings now with new market entrants. Do you think German OEMs like VW or Audi will remain in the Chinese market?
I	• German OEMs will stay in China due to its large market share (40% of the global EV market) • Investments from brands like BMW, VW, and Benz indicate their commitment to the Chinese market
XS	Do you think Chinese consumers prefer German cars over local brands, and why?
I	• Previously, brands were associated with quality, but local brands now offer comparable quality at better prices • Customers are more informed and prioritize cost over brand loyalty • Sales for VW and BMW dropped by over 10% in early 2024 • Many owners of German cars are choosing local brands for their second car
XS	Are German cars more focused on the premium segment, or do they cater to the broader market in China?
I	• German brands like VW cover a wide price range through joint ventures with local partners • German cars are perceived as high-quality, regardless of whether they are premium or more affordable
XS	Why do you think companies like Xiaomi or Huawei, traditionally from electronics, are entering the automotive market?
I	• Xiaomi:

	○ Aims to build a complete ecosystem, not just focus on one product category ○ Uses its strong investment network and IoT expertise to expand into automotive • Huawei: ○ Focuses on technological innovations like autopilot, motors, batteries, and control units ○ Built their own supply chains and production lines for flexibility and cost control • Both companies leverage their existing expertise and infrastructure to enter the automotive market strategically
XS	Do you think Xiaomi can differentiate itself and attract customers away from traditional automotive companies?
I	• Success depends on product positioning, technology, supply chain management, customer targeting, and service • Xiaomi has invested heavily in autopilot engineers, motor design, and battery partnerships with companies like BYD • Building their own production lines ensures cost efficiency and design flexibility
XS	What changes would German OEMs need to make in the Chinese market to stay competitive against new entrants like Xiaomi?
I	• German OEMs need to increase their speed and flexibility to match the rapid development cycles of local competitors (e.g., reducing development time from 3–5 years to 8 months) • Local teams must have more autonomy to adapt to market demands • German OEMs must rethink traditional global strategies that delay customization for local markets
XS	Would you say German OEMs are not customizing enough for the Chinese market, such as integrating larger screens into cars?
I	• Customization is hindered by global strategies and rigid processes that delay decision-making • German OEMs need to prioritize local client preferences over global strategies • A mindset shift is required to proactively implement changes ahead of competitors
XS	Imagine you are the head of a German OEM like VW or BMW. What changes would you implement to stay competitive in China?
I	• Restructure organizations to allow local teams to lead certain categories • Make the organization flatter and more flexible to respond quickly to regional demands • Treat China as a distinct market rather than aligning it too closely with Europe or the US

XS	Why do you think the European market is attractive for non-automotive companies like Xiaomi?
I	• Overseas markets like Europe are less competitive on costs compared to China, making them attractive • Policy challenges in Europe require companies to establish local production facilities, but Xiaomi's expertise and technology give them a competitive edge
XS	Do you think Xiaomi could successfully establish an ecosystem similar to what German OEMs have in terms of dealer networks, workshops, and Tier-1 suppliers?
I	• Xiaomi can adapt its ecosystem approach to the European market by leveraging digital tools and data collection • While customer habits may differ, data analysis can help Xiaomi tailor its offerings to local needs
XS	To summarize, what are the main points German OEMs need to focus on to stay competitive in China?
I	• Flexibility, speed, and customization. • Allowing local teams to take the lead in decision-making. • Adapting to a cost-driven market while maintaining quality.
XS	Do you think German OEMs will still have a chance in China in the next five to ten years?
I	• Yes, due to their strong supply chains and technological expertise. • However, they must shift from a technology-first approach to a cost-first strategy to stay relevant.

Appendix K – Summary of Interview J

XS	The transformation of the automotive industry is often described with three major trends: e-mobility, autonomous driving, and shared mobility. Do you see these as trends or rather as permanent changes?
J	• These are structural shifts, not just trends • E-mobility is the cornerstone of the future due to its efficiency and sustainability benefits, supported by regulations • Autonomous driving is progressing slower due to technological and regulatory challenges but will revolutionize mobility services in the long term • Shared mobility depends on urbanization and societal attitudes, making its growth more volatile
XS	How do you assess the competitiveness of German automakers?
J	• German automakers excel in engineering and manufacturing but lag behind in software and battery technology

	• Chinese automakers benefit from state support and rapid advancements in EV development • German OEMs must accelerate battery supply chain integration and software innovation to remain competitive
XS	What do you believe are the biggest challenges facing the German automotive industry today?
J	• Regulatory uncertainty delays investment decisions • High energy and labor costs in Germany reduce competitiveness • A digital and software skills gap hampers the transition to software-defined vehicles • Close collaboration between industry and policymakers is essential to address these challenges
XS	What role do you see for tech companies like Xiaomi and Huawei in the future automotive ecosystem? Are they a serious threat to traditional OEMs?
J	• Tech companies are gaining importance due to their expertise in software and consumer electronics • Xiaomi integrates vehicles into larger digital ecosystems, appealing to tech-savvy consumers • A major challenge for new entrants remains the establishment of global dealership and service networks
XS	What should German OEMs do to remain competitive, especially in attracting skilled talent?
J	• Focus on upskilling and reskilling their workforce to meet software expertise demands • Create a more flexible and dynamic work environment to attract global talent • Collaborate with tech companies to integrate innovative digital solutions while leveraging their strengths in vehicle engineering
XS	What strategies can automakers use to make electric vehicles more appealing to mainstream consumers?
J	• Reducing the upfront cost of EVs through battery innovations and incentives is key • Enhancing the driving range and reducing charging times can address range anxiety • Offering creative ownership models, like subscription-based EV access or battery leasing, can make EVs more accessible
XS	Do you think Chinese EV manufacturers will succeed in Europe, or will cultural and market differences limit their impact?
J	• Chinese manufacturers like BYD and Nio have competitive products, but European consumers value established brands and local service networks • Price competitiveness is important but not sufficient without strong brand perception and after-sales support
XS	What impact do you see autonomous driving having on ownership models?

I	• Autonomous driving will likely complement shared mobility rather than replace traditional ownership in the near term. • Urban areas may see a shift toward shared fleets of autonomous vehicles, while personal car ownership will remain dominant in rural areas due to limited mobility alternatives.
XS	Why do you think Xiaomi could become more competitive than traditional German OEMs?
J	• Xiaomi has an advantage due to its strong background in consumer electronics and its ability to innovate quickly. • Its ecosystem strategy integrates vehicles seamlessly with other connected devices, appealing to younger, tech-savvy consumers. • Xiaomi's agile development cycles and cost-efficient production methods contrast with the slower processes of traditional OEMs. • However, Xiaomi still faces challenges, such as building trust in its brand as an automaker and establishing a robust global network of dealerships and service centers.

Appendix L – Summary of Interview K

XS	What trends do you currently perceive in the automotive industry, and how do you see their future development?
K	• Autonomous driving is progressing quickly, especially in China • Europe is more cautious regarding trends historically, including in the automotive industry • U.S.: More open to autonomous driving but limited major players in e-mobility besides Tesla • China: Currently the trendsetter for both e-mobility and autonomous driving
XS	Do you think German automakers are lagging behind, especially compared to China?
K	• Yes, German automakers' offerings are not at the same level • Chinese manufacturers have made faster advancements in the last 5–10 years by adopting multi-shift development processes, unlike German companies
XS	Are there other factors that slow down German automakers in the transformation process?
K	• Slow development cycles due to extensive safety protocols and testing • Conservative work culture in Germany's automotive industry • Unions and tariff systems discourage performance and prevent agile work practices • A lack of software experts and challenges in retraining traditional engineers for e-mobility and autonomous driving
XS	Is leadership partly responsible for employees' reduced performance or motivation?

K	• Leadership is not the issue; it focuses on performance • The problem lies in cultural aspects and union systems that prioritize job security over productivity
XS	Would you say German automakers need to take more risks to remain competitive?
K	• No, risk-taking could harm the premium image, which is essential for maintaining status • However, there is concern about whether the premium segment will remain viable in the future, especially as consumer preferences in China shift toward "hip" domestic brands
XS	Do you think features like seamless digital integration (e.g., controlling appliances from cars) will become important in Europe as they are in China?
K	• European manufacturers need to adapt for the Chinese market • It's uncertain whether these features will gain the same popularity in Europe due to differing customer preferences and data privacy regulations • Developing separate solutions for China and Europe risks creating two suboptimal systems.
XS	Do German automakers need to improve their approach to the Chinese market?
K	• Yes, they need to adapt more quickly to changing customer preferences in China • Current efforts are too slow, and tech companies like Xiaomi have a broader ecosystem advantage (e.g., seamless integration across devices)
XS	Could Chinese automakers succeed in the European market?
K	• Yes, Chinese cars will find customers in Europe • Initial challenges include regulatory hurdles, lack of service networks, and quality skepticism • Over time, these issues will be addressed, and Chinese brands will gain market share • But regulatory hurdles (e.g., data protection), lack of established dealer and networks initially and skepticism from European customers regarding Chinese car quality
XS	What are the strengths of German automakers?
K	• High quality, delivering what is promised • Strong traditional performance and driving experience • Established dealer and service networks, ensuring good customer support and loyalty
XS	How do you see the automotive market evolving in the next 10 years?
K	• VW will face significant pressure in the price-sensitive segment • Growth in China will primarily benefit domestic brands, with European brands playing a secondary role • In Europe, not all premium brands (e.g., BMW, Mercedes, Audi) will survive without significant adaptation
XS	What are the key factors for German automakers' long-term survival?

K	• Speed: Faster development and adaptation • Cost efficiency: Reducing overhead and streamlining processes • Boldness: Developing innovative and unique products rather than overly calculated offerings

Appendix M – Survey Questions and Hypotheses Development

INTRODUCTION

(Please choose your language in the right upper corner)
Hello!

Thank you for helping me with my Master's thesis at the Católica Lisbon School of Business and Economics. In this study, I am analyzing consumers' willingness to buy and perceptions of vehicles produced and marketed by non-automotive companies.

The questionnaire will take approximately 5-6 minutes to complete. All information collected will remain anonymous and will only be used for scientific purposes. There are no right or wrong answers, so please be as honest as possible.

If you have any questions or feedback about the survey, please do not hesitate to contact me by email: s-xscheffold@ucp.pt

Thank you for your participation!

BLOCK 1 – Socio-demographic factors

Q1: How old are you?
<25
25-34
35-44
45-64
>65

Q2: What gender do you identify with?
Male
Female
Diverse

Q3: What is your current level of education?
Secondary school or less
High school diploma
Vocational training
Bachelor's degree
Master's degree or higher

Q4: Which of these categories describes your average personal income per month after tax?

Less than 1.000€
1.000€-3.000€
3.000€-5.000€
5.000€-10.000€
More than 10.000€

Q5: Which is your level of driving experience?
Never driven
Less than 1 year
1-3 years
3-5 years
More than 5 years

Q6: What is your primary mode of travel?
Public transportation
Private car
Taxi/Carsharing
Motorcycle/Motor scooter
Bike/Bike sharing/Scooter sharing

Q7: What is your level of experience with electric vehicles?
Never used
Rare use
Occasional use
Frequent use
Daily use

Q8: What is your level of experience with driving assistance (e.g., fatigue detection, lane departure warning)?
Never used
Rare use
Occasional use
Frequent use
Daily use

Q9: What type of area do you live in?
In a city/urban area
In a small town
In a suburban area/town
In a rural/remote area

Q10: Please specify your nationality
Q11: In which country do you currently reside?

BLOCK 2 – Constructs		
Construct	**Items/Statements**	**Adapted from**
Willingness to buy	• I can easily imagine buying a car from a non-automotive company in the future • I expect that I would likely buy a car from a non-automotive company	Monroe & Krishnan, 1985; Zeithaml, 1988
Perceived value	• A car from a non-automotive company likely offers features and performance that justify a higher price • A higher price for a car from a non-automotive company would likely be justified by its unique features and performance	Monroe & Krishnan, 1985; Zeithaml, 1988
Perceived sacrifice	• I believe that buying a car from a non-automotive company would require me to give up certain features • When purchasing a car from a non-automotive company, I would likely have to give up certain features	Monroe & Krishnan, 1985; Zeithaml, 1988; Teas & Agarwal (2000)
Perceived quality	• Cars from non-automotive companies are likely to have high build quality and reliability • Cars from non-automotive companies are likely to stand out due to their reliability and high build quality	Monroe & Krishnan, 1985; Zeithaml, 1988
Perceived risk	• Buying a car from a non-automotive company might be risky for me • I see potential risks in buying a car from a non-automotive company	Choi & Ji, 2015
Perception of price	A recently introduced electric vehicle from a non-automotive company is available at a significantly lower price point than a comparable model from a German OEM (e.g., VW, BMW, Porsche, etc.). Both vehicles offer comparable driving ranges and features.	Zeithaml, 1988; Monroe & Grewal, 1991
	• I would buy the cheaper car of the non-automotive company • I would not be willing to pay a premium for an EV from an original German manufacturer compared to one produced by a company outside the industry (with the same characteristics)	
Perception of brand	• Because of their technological innovation, non-automotive entrant brands appeal to me • The innovative technologies of non-industry companies make their brands attractive to me	Monroe & Grewal, 1991
Trust	• Cars from non-automotive companies are reliable • Overall, I can trust cars manufactured by non-automotive companies	Choi & Ji, 2015

Technical competence	• I believe that cars from non-automotive entrants are advanced in terms of AI, software integration, and digital features • I believe that cars from non-automotive companies are technically mature and will consistently perform under a variety of circumstance	Choi & Ji, 2015

Hypothesis Development:

H1: Perceived value has a positive effect on willingness to buy.

H2: Perceived quality has a positive effect on perceived value.

H3: Perceived sacrifice has a negative effect on perceived value.

H4: Perceived brand has a positive effect on perceived quality.

H5: Perceived price has a positive effect on perceived quality.

H6: Perceived price has a positive effect on perceived sacrifice.

H7: Perceived risk has a positive effect on perceived sacrifice.

H8: Trust has a negative effect on perceived risk.

H9: Technical competence has a positive effect on trust